THE 'MANIHINE' EXPEDITION TO THE GULF OF AQABA 1948–1949

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ZOOLOGY Vol. 1 No. 8
LONDON: 1952

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THE 'MANIHINE' EXPEDITION TO THE GULF OF AQABA

I. FOREWORD: STATION LIST AND COLLECTORS' NOTES

DURING the winter of 1948–1949 the motor-yacht *Manihine* was engaged in biological investigations in the Gulf of Aqaba on behalf of the British Museum (Natural History), the work being under the supervision of Mr. N. B. Marshall.

This gulf is of special interest because in it the peculiarities of the Red Sea appear at their most intense. The Red Sea is geologically young with a fauna derived from that of the Arabian Sea and, possibly, the Mediterranean. This immigrant fauna is now completely isolated from the last-mentioned and also partially isolated from the former by reason of the narrowness and shallowness of the connecting passage, the Strait of Bab-el Mandeb. It also finds itself in a region where some, at least, of the ecological conditions are very different. The most noticeable of these ecological differences is to be found in the isohaline and isothermal nature of the water below 200 metres and the complete absence of any cold, deep-water layer. The John Murray Expedition (Seymour Sewell, 1935, *John Murray Exp.*, *Reports*, **1,** 1) recorded temperatures from 21·64 to 21·84° C. at depths of 1,000 to 1,900 metres in the Red Sea, but at similar depths in the Gulf of Aden the temperature was at least 10° C. lower (3·59–11·53° C.). The degree of isolation of the Aqaba fauna is greater than that of any other part of the Red Sea since the passage between the two, the Strait of Tiran, provides only a restricted channel for faunal interchange. The strait is both narrow and shallow, forming a distinct sill, with a greatest depth of less than about 300 metres; on either side of the sill the water deepens rapidly to 1,000 metres and upwards. The hydrological conditions inside the gulf appear to be essentially similar to those in the Red Sea proper, though, as might be expected, salinities are somewhat higher.

In this Bulletin are reports on some of the collections that were brought back. Other reports, including a study of the interchange of heat and water vapour between the surface water and the air, will be prepared as opportunities offer, but in some instances the collections will be studied in conjunction with other material and will not form the subject of a special report.

Acknowledgements and thanks are due to many individuals and institutions whose material aid or advice contributed greatly to the expedition. Foremost among them is Major H. W. Hall, O.B.E., M.C., who not only provided the ship and was responsible for most of the preliminary organization, but who, with Mrs. Hall, accompanied the expedition taking a large share of the actual collecting and doing most of the photography. A small selection of the photographs is published here to give a general impression of the gulf and its surroundings. Many localities could not have been visited but for the skilful pilotage of Captain Hargreaves through poorly charted

waters, and to him, and to his hard-working crew, all possible thanks are due. The Hydrographer of the Navy and the Director of 'Discovery Investigations' lent apparatus vital to the expedition and His Excellency the Egyptian Ambassador in London made arrangements that ensured pleasant and harmonious relations wherever the ship was in Egyptian waters. Lastly, thanks are due to the Government Chemist, whose department carried out the analyses of salinities.

Except for the plankton and some of the fishes all material was obtained from littoral areas and coral reefs (or coral patches). Localities where collections were made are indicated on the chart. Within the Gulf of Aqaba (reading from north to south) these were:

Aqaba (Pl. 22, fig. 1)
Faraun Island (Pl. 22, fig. 2)
Graa
Mualla (Pl. 23, fig. 3)
Hobeik (Pl. 23, fig. 4)
Dahab (Pl. 24, fig. 5)
Um Nageila (Pl. 24, fig. 6)
Abu Zabad

Along the Sinai shores there are well-formed coral reefs at Dahab and from Um Nageila southwards. The bulk of the invertebrate material was obtained from these regions, particularly from Abu Zabad on the 10th and 11th February 1949 when there were low spring tides. North of Dahab there were coral patches at all localities visited, but these never become massed to form a definite reef.

Outside the gulf collections were made at the following localities:

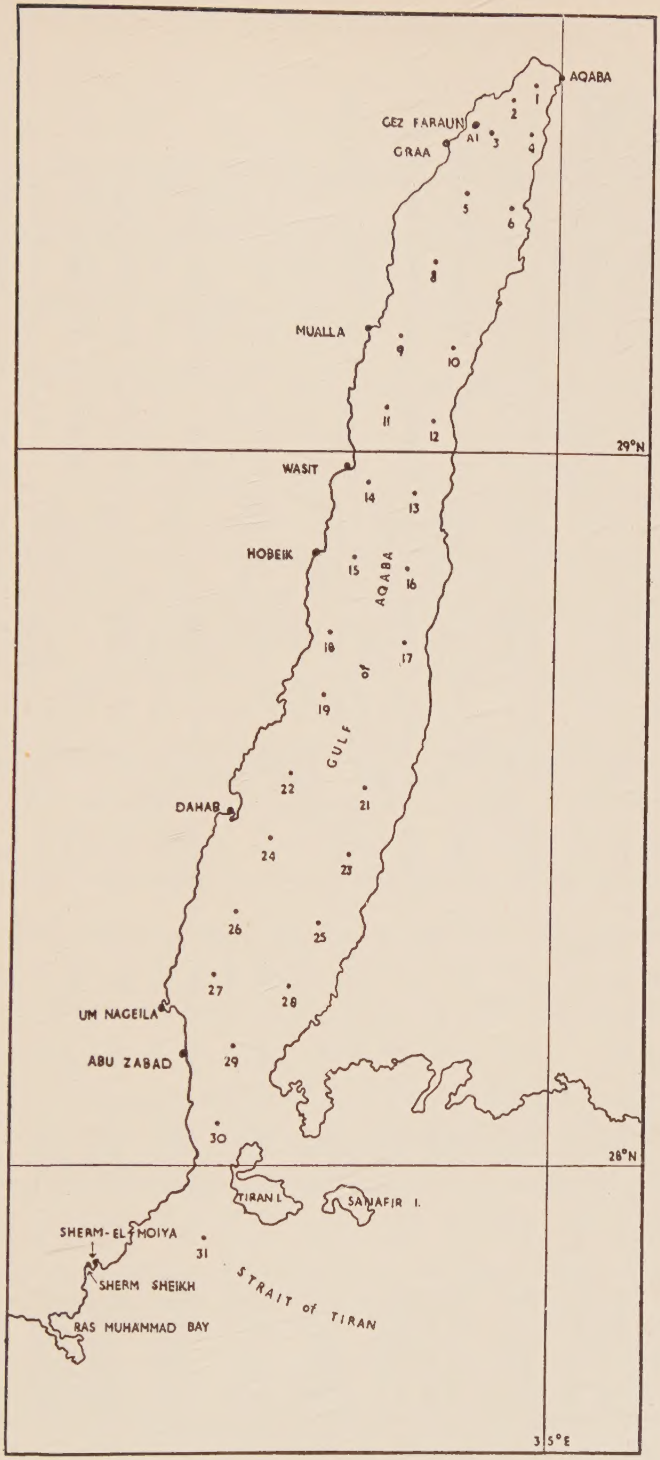
Sanafir Island (Pl. 25, fig. 7)
Tiran Island (Pl. 25, fig. 8)
Sherm Sheikh
Sherm-el-Moiya (Pl. 26, fig. 9)
Ras Muhammad Bay (Pl. 26, fig. 10)

Most time was spent on Sanafir Island, where there were well-formed coral reefs. Here, as elsewhere, much material was collected by diving for pieces of coral and extracting the small invertebrates and fishes.

It will be observed that in the Station List no temperatures are given for depths below 40 metres. It was, however, established that at all stations where deep-water samples were taken (i.e. where salinity figures are given in the list) the temperature exceeded 18·5° C.

The following are the meanings of the abbreviations used in the list.

D.M. = Dredge, medium.
D.S. = Dredge, small.
K.T. = Kelvin tube.
N. 70 V. = Vertical haul by silk plankton net with mouth 70 cm. diameter.
N. 100 V. = Vertical haul with stramin plankton net with mouth 100 cm. diameter.
O.T.L. = Otter trawl, large.



The Gulf of Aqaba.

The positions of the numbered stations are given in the station list.

Station	Position	Date	Hour L.M.T.	Sounding (metres)	Wind: Direction	Wind: Force	Barometer (inches)	Hydrological obs.: Depth (metres)	Hydrological obs.: Temp. °C.	Hydrological obs.: S‰	Bathythermograph obs.: Depth (metres)	Bathythermograph obs.: Temp. °C.	Biological observations: Gear	Biological observations: Depth (metres)	Biological observations: Time From	Biological observations: Time To	Remarks
A 1	29° 26′ 30″ N. 34° 51′ 30″ E.	1948 31.xii	1140– 1237	40	N.	3	29·8	0	22·1	40·8	—	—	D.M. D.S. N. 100 V.	40 40 36	1155 1227 1215	1200 1231 1225	No catch: net torn off. No catch. K.T.
1	29° 30′ 54″ N. 34° 57′ 30″ E.	1949 15.i	1300– 1415	356	S.	1	29·55	0 137 274	21·59 — —	40·79 40·78 40·38	0 40	21·4 20·8	N. 100 V.	c. 180	1340	1355	
2	29° 29′ 54″ N. 34° 55′ 30″ E.	15.i	1435– 1500	165	S.	1	29·55	0 137	21·65 —	40·78 40·71	0 40	21·3 20·8	N. 100 V.	73	1440	1455	K.T.
3	29° 27′ 00″ N. 34° 53′ 36″ E.	15.i	1515– 1555	289	S.	1	29·5	0 137 219	21·61 — —	40·77 40·67 40·8	0 40	21·3 20·9	N. 100 V.	79	1550	1600	K.T.
4	29° 26′ 6″ N. 34° 57′ 18″ E.	15.i	1625– 1655	713	S.	1	29·55	0 274 549	21·62 — —	40·78 — 40·72	0 40	21·3 21·0	N. 100 V.	—	—	—	Net lost.
5	29° 21′ 36″ N. 34° 51′ 12″ E.	16.i	1150– 1410	642	SW.	2	29·35	0 137 274	21·61 — —	40·72 40·68 40·8	0 40	21·1 20·8	N. 70 V.	c. 140	1255	1310	
6	29° 20′ 18″ N. 34° 55′ 24″ E.	16.i	1010– 1115	697	SW.	2	29·35	0 137 274	21·56 — —	40·74 40·8 40·79	0 42	21·1 20·8	N. 70 V.	c. 140	1105	1115	
8	29° 15′ 42″ N. 34° 47′ 42″ E.	16.i	1350– 1440	274	SW.	1	29·35	0	21·72	40·79	0 42	21·1 20·8	N. 70 V.	c. 140	1422	1435	
9	29° 09′ 24″ N. 34° 45′ 24″ E.	16.i	1455– 1540	830	SW.	1	29·35	0 274 548	21·57 — —	40·75 40·79 40·66	0 42	21·2 20·8	N. 70 V.	c. 140	1515	1527	
10	29° 08′ 30″ N. 34° 50′ 00″ E.	17.i	0845– 1000	914	SW.	1	29·3	0 274 731	21·38 — —	40·8 40·72 40·68	0 42	21·1 20·7	N. 70 V.	c. 180	0940	1000	
11	29° 03′ 36″ N. 34° 43′ 00″ E.	17.i	1105– 1125	293	SW.	1	29·3	0	21·51	40·76	0 40	21·1 20·8	N. 70 V.	c. 140	1113	1125	
12	29° 02′ 00″ N. 34° 48′ 30″ E.	17.i	1015– 1045	805	SW.	1	29·3	0	21·53	40·77	0 42	21·1 20·8	N. 70 V.	c. 180	1025	1045	
13	28° 56′ 12″ N. 34° 46′ 42″ E.	17.i	1240– 1330	1019	SW.	2	29·4	0	22·0	40·74	0 40	21·3 20·7	N. 70 V.	c. 140	1309	1325	

14	28° 57′ 00″ N. 34° 42′ 30″ E.	17.i	1145– 1215	503	SW.	1	29·3	0 137 274	21·63 — —	40·73 40·75 40·74	0 42	21·0 20·7	N. 70 V.	c. 180	1158	1215	
15	28° 50′ 48″ N. 34° 41′ 24″ E.	18.i	0930– 1000	598	S.	1	29·55	0	21·35	40·71	0 42	21·2 20·7	N. 70 V.	c. 180	0940	1000	
16	28° 49′ 54″ N. 34° 46′ 06″ E.	18.i	1025– 1110	> 1500	S.	1	29·55	0	21·74	40·70	0 42	21·1 20·8	N. 70 V.	c. 180	1035	1110	
17	28° 43′ 36″ N. 34° 45′ 26″ E.	18.i	1150– 1220	—	S.	1	29·55	0 137 274	21·88 — —	40·63 40·71 40·73	0 42	21·4 21·0	N. 70 V.	c. 180	1200	1220	
18	28° 44′ 30″ N. 34° 38′ 24″ E.	18.i	1310– 1415	942	S.	1	29·55	0	21·57	40·78	0 42	21·1 20·7	N. 70 V.	c. 180	1348	1415	
19	28° 39′ 06″ N. 34° 38′ 00″ E.	18.i	1430– 1530	> 1460	S.	1	29·5	0 137 820	21·58 — —	40·78 40·74 40·66	0 40	21·2 20·7	N. 70 V.	c. 180	1505	1530	
21	28° 31′ 30″ N. 34° 42′ 18″ E.	19.i	1120– 1200	—	NW.	2	29·65	0 137 550	21·56 — —	40·70 40·74 40·64	0 40	21·1 20·8	N. 70 V.	c. 180	1145	1200	
22	28° 32′ 48″ N. 34° 35′ 00″ E.	19.i	1000– 1040	—	NW.	2	29·65	0 137 550	21·22 — —	40·76 40·72 40·67	0 40	21·1 20·8	N. 70 V.	c. 180	1009	1040	
23	28° 25′ 36″ N. 34° 40′ 54″ E.	19.i	1230– 1300	—	NW.	2	29·65	0	21·81	40·53	0 40	21·5 20·9	N. 70 V.	c. 180	1240	1300	
24	28° 27′ 12″ N. 34° 33′ 20″ E.	19.i	0900– 0930	850	NW.	2	29·65	0	21·20	40·75	0 33	20·9 20·7	N. 70 V.	c. 180	0909	0930	
25	28° 20′ 12″ N. 34° 38′ 12″ E.	19.i	1400– 1430	—	N.	2	29·6	0	22·20	40·61	0 26	21·7 21·3	N. 70 V.	c. 180	1410	1430	
26	28° 20′ 54″ N. 34° 30′ 18″ E.	20.i	0900– 0920	—	N.	3	29·65	0	21·40	40·70	0 33	21·2 21·0	N. 70 V.	c. 180	0903	0920	
27	28° 15′ 42″ N. 34° 28′ 00″ E.	20.i	0950– 1045	—	N.	3	29·65	0 137 550	21·45 — —	40·59 40·66 40·66	0 38	21·4 21·1	N. 70 V.	c. 180	1020	1045	
28	28° 14′ 36″ N. 34° 35′ 12″ E.	20.i	1125– 1210	—	NNE.	4	29·6	0 137 460	21·44 — —	40·66 40·66 40·66	0 35	21·3 21·0	N. 70 V. O.T.L.	c. 180 c. 250	1149 1300	1210 1500	Catch nil.
29	28° 09′ 30″ N. 34° 30′ 6″ E.	21.i	1000– 1030	—	N.	2	29·75	0	21·50	40·66	0 42	21·1 20·9	N. 70 V.	c. 180	1008	1030	
30	28° 03′ 00″ N. 34° 28′ 42″ E.	21.i	1100– 1150	—	N.	2	29·75	0 137 550	22·38 — —	40·50 40·66 40·68	0 42	21·9 21·4	N. 70 V.	c. 180	1129	1150	
31	27° 53′ 24″ N. 34° 27′ 36″ E.	3.ii	1400– 1445	—	N.	1	29·6	0 137 730	22·54 — —	40·48 40·46 40·48	0 38	21·7 21·1	N. 70 V.	c. 180	1425	1445	

Stations 7 and 20 were planned but never worked.

Legends to Plates 22–27.

PLATE 22

FIG. 1. Aqaba looking north-east.
FIG. 2. Gezeret-el-Faraun from the south-east.

PLATE 23

FIG. 3. Looking north from the anchorage at Mualla.
FIG. 4. Hobeik.

PLATE 24

FIG. 5. Typical gulf scenery. Coast 5 miles south of Dahab.
FIG. 6. Mangrove swamps at Um Nageila.

PLATE 25

FIG. 7. Sanafir Island; Fish-eagle's nest.
FIG. 8. Tiran Island, seen from Sanafir.

PLATE 26

FIG. 9. Sherm-el-Moiya; looking north-east from the entrance.
FIG. 10. *Manihine* at anchor in Ghazulani Bay with Ras Muhammad in the distance.

PLATE 27

FIG. 11. Abandoned police post at Naweibi-el-Terabin, about 45 miles south of Aqaba.
FIG. 12. Arab fisherman using cast net.

FIG. 1. AQABA

FIG. 2. GEZERET-EL-FARAUN

Fig. 3. MUALLA

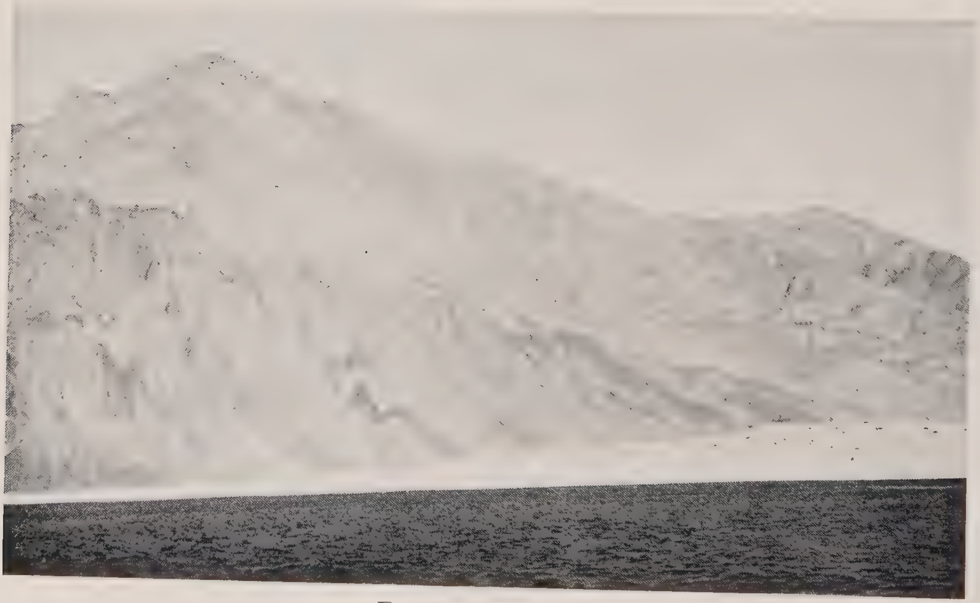


Fig. 4. HOBEIK

FIG. 5. GULF SCENERY NEAR DAHAB

FIG. 6. UM NAGEILA

FIG. 7. SANAFIR ISLAND

FIG. 8. TIRAN ISLAND

FIG. 9. SHERM-EL-MOIYA

FIG. 10. GHAZULANI BAY

Fig. 11. NAWEIBI-EL-TERABIN

Fig. 12. CAST NET

II. PRELIMINARY HYDROLOGICAL REPORT

By G. E. R. DEACON, F.R.S.

NATIONAL INSTITUTE OF OCEANOGRAPHY

The observations confirm the general picture of the water circulation described by A. F. Mohammed in *Proc. Roy. Soc.* B. **128,** 1939, and give some new information about the surface layer.

As plotted in Fig. 1, the surface water at Stations 30 and 31 in the Straits of Tiran, and at Station 23 twenty miles farther north on the east side of the gulf, had a salinity less than 40·6‰ which can be attributed to the inflow of water from the Red Sea. There is some indication that the inward movement has a greater influence on the east side of the gulf since the surface salinity at Station 17 nearly half-way up the gulf is only 40·63‰. For the remainder of the gulf, including all stations north and west of a line from Station 26 to Station 17, the water between the surface and 20 fathoms can be regarded as almost isothermal and isohaline, with a temperature of 21° to 22° C. (in January) and a salinity of 40·7 to 40·8‰.

Excepting Stations 31, 30, and 25, the observed surface temperature appears to depend more on the time of day at which the measurement was made than the position of the station in the gulf. When plotted against time of day (Fig. 2) the temperatures lie fairly closely about a curve of diurnal temperature change which has a maximum at approximately 13.00 hours. The bathythermograph observations made at all the stations always show a temperature less than that measured by taking a surface sample and using a thermometer. Some of the differences can be attributed to the shallower depth of the sample scooped up in a surface sampler, and to the existence of an appreciable thermal gradient in the first foot or two of water. The differences between the thermometer and bathythermograph readings when plotted against the time of day (Fig. 3) lie fairly closely about a curve with a maximum of 0·55° C., which is very similar to that showing the diurnal temperature variation (Fig. 2) at 13.00 hours. The differences between the readings at the surface and a depth of 40 metres on the bathythermograph slides (Fig. 4) shows that this difference, which varies between 0·2° and 0·6° C., varies according to a similar curve.

It is expected that some further information about the interchange of heat and water vapour between the surface water and the air can be obtained from the data, and, when some attempt is made to smooth out the diurnal temperature variations, one or two useful indications of the surface movements; but the best that can be done at present is to regard the upper 40 metres of water as more or less uniform, excepting Stations 31, 30, and 23. These appear to be influenced by the inflow of surface water from the Red Sea. Reference to Fig. 1 will also show that the stations near the eastern shore in the southern part of the gulf appear to be influenced by a more recent inflow of water than those farther north and west.

FIG. 1. Surface salinities. The underlined figures are the station numbers.

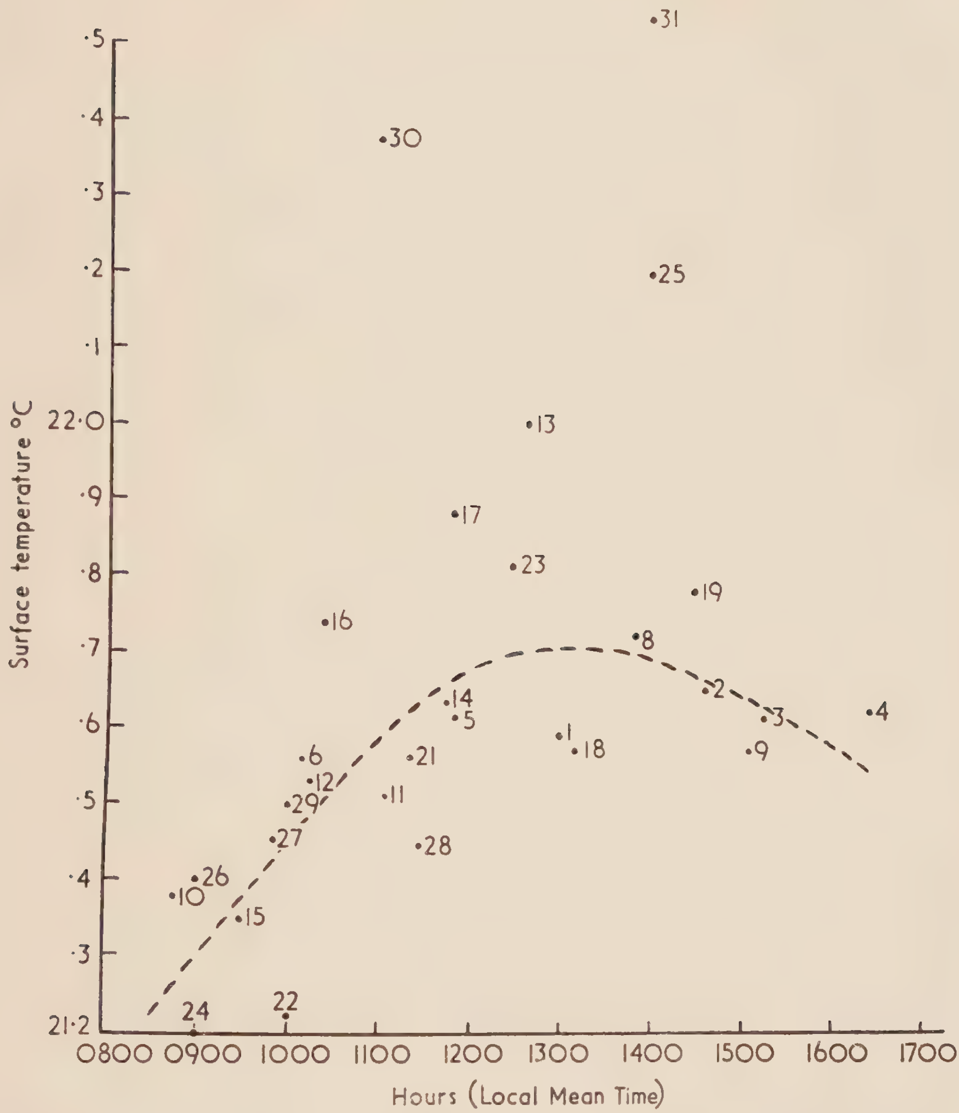


FIG. 2. Surface temperature in relation to time of day. (Numbers refer to stations.)

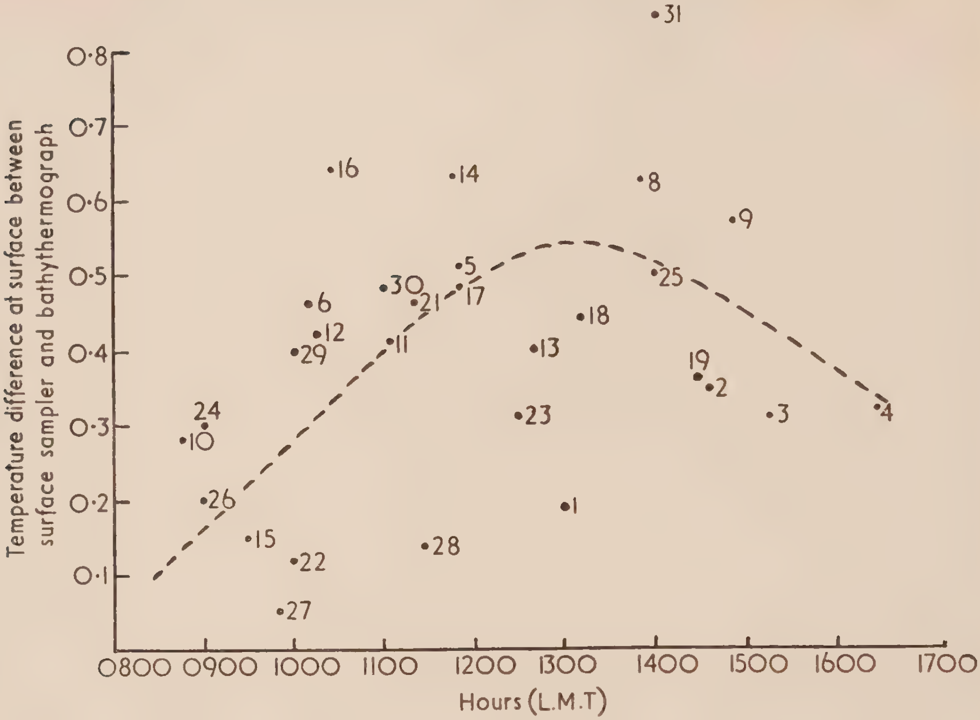


FIG. 3. Difference of temperature between surface samples and bathythermograph 'surface' recordings, plotted against time of day. (Numbers refer to stations.)

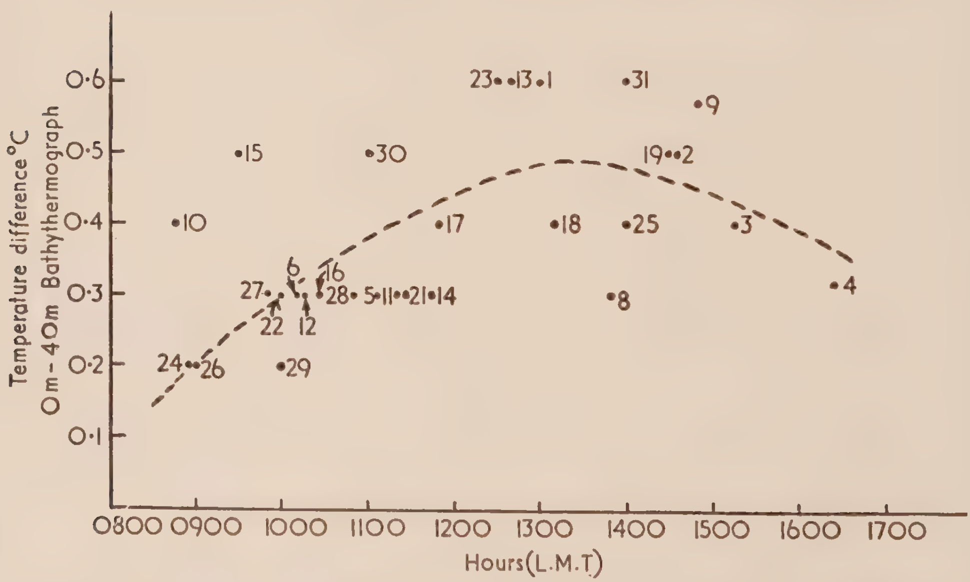


FIG. 4. Difference between temperature at surface and at 40 metres, plotted against time of day. (Numbers refer to stations.)

III. SPONGES

By MAURICE BURTON, D.SC.

The sponges represent thirty-three species, and although their study has resulted in little of unusual interest, a useful addition to the faunal list of the Red Sea area has been made. In addition, it has been possible to establish the correct identity of some of the forms described by Keller (1889 and 1891), which has long been in doubt. Most of the thirty-three species are common to the Indian Ocean fauna, some having been recorded also from Australia or the Indo-Pacific. It is of interest to note, however, that twelve species appear to be endemic, but this may be due largely to gaps in our knowledge of the Indian Ocean fauna. Furthermore, there are three species (*Leuconia nausicae*, *Tethya aurantium*, and *Pseudosuberites mollis*) belonging more properly to the Mediterranean fauna.

The commonest form in the Gulf of Aqaba seems to be *Callyspongia viridis*, which, according to the members of the expedition, is 'abundant everywhere'.

LIST OF SPECIES AND SYSTEMATIC NOTES

Order CALCAREA

Leucosolenia canariensis (Michlucho-Maclay)

Nardoa canariensis Michlucho-Maclay, 1868: 221.
Leucosolenia canariensis, Dendy & Row, 1913: 724.

Occurrence. Mualla, 30.i.49, under rocks at low tide; Sherm-el-Moiya, 3.ii.49.

Remarks. A greyish white, typical specimen, 10 mm. across.

Distribution. Arctic; Mediterranean; Cape Verde Islands; Canaries; Red Sea; Mauritius; NW. Pacific (Commandorski Islands).

Leucosolenia tenuipilosa Dendy

Leucosolenia (*Clathrina*) *tenuipilosa* Dendy, 1905: 227, pl. xiii, fig. 9.
L. canariensis (pars), Thacker, 1908: 762.
Clathrina tenuipilosa, Row, 1909: 185.
Leucosolenia tenuipilosa, Dendy & Row, 1913: 723.

Occurrence. Dahab, 14.ii.49; Abu Zabad, 11.ii.49.

Remarks. There are a number of typically cushion-shaped specimens, up to 30 mm. across, which were brown or fawn in formalin, and now, in spirit, are coloured a greyish brown.

Distribution. Ceylon; Red Sea; Cape Verde Islands.

Grantessa glabra Row

Grantessa glabra Row, 1909: 203, pl. xix, figs. 5–6; Dendy & Row, 1913: 752.

Occurrence. Sherm Sheik, 11.i.49; Abu Zabad, 10.ii.49, on reef at low tide.

Distribution. Red Sea.

Leuconia bathybia (Haeckel)

Dyssycum bathybia Haeckel, 1869: 241.
Leucaltis bathybia, idem, 1872: 156, pl. xxviii, fig. 2.
Leucandra bathybia, Dendy & Row, 1913: 773.

Occurrence. Sherm Sheik, 2.ii.49, 2 fms.; Sanafir, 6.ii.49.

Remarks. The four specimens may possibly represent two well-marked varieties, and, since the species was originally subdivided in this manner, it may be worth while to consider them in this light.

The first specimen is the smaller, a few millimetres high, and of typical form and colour. The skeleton is arranged as Haeckel described it, and the rays of the large quadriradiates have a maximum of 0·4 by 0·032 mm.

The other three range from a few millimetres high to 16 mm. high by 12 mm. diameter. Again, the external form is typical, as well as the spiculation. But in these three the rays of the quadriradiates have a maximum of 0·96 mm. by 0·09 mm.

Either the first of the present specimens represents Haeckel's var. *perimina* and the other three var. *arabica*, or, what is much more likely, we have to deal with a species showing a tendency to vary widely in the measurements of the spicules.

The first specimen and two out of the group of three were found at the same station, Sherm Sheik.

Distribution. Red Sea; ? Australia.

Leuconia nausicae (Schuffner)

Leucaltis nausicae Schuffner, 1877: 407, pl. xxiv, fig. 1.
Leucandra nausicae Dendy & Row, 1913: 774.

Occurrence. Sanafir, 9.i.49; Tiran, 10.i.49; Abu Zabad, 11.ii.49, on reef at low tide.

Remarks. The two specimens seem to agree closely with the description of the holotype, which is the only other recorded specimen. Presumably Row (l.c.) examined this and, as a consequence, the species was transferred to *Leucandra*. It is difficult, therefore, to accept Topsent's (1937: 14) remark that '*Leucaltis Nausicae* Schuffner se confond vraisemblablement avec *Leucetta solida* (O. Schmidt)'.

Distribution. Mediterranean.

Kebira uteoides Row

Kebira uteoides Row, 1909: 210, pl. xx, figs. 8–9, text-figs. 7–8; Dendy & Row, 1913: 785.

Occurrence. Sherm Sheik, 2 fms., 2.ii.49.

Remarks. The single specimen, 20 mm. high, is typical, in both external appearance and the details of the skeleton.

Distribution. Red Sea.

Order TETRAXONIDA

Stelletta purpurea Ridley

(For synonymy *see* Burton, 1926.)

Occurrence. Tiran, 10.i.49; Sanafir, 8 and 9.i.49 and 4.ii.49; Sherm-el-Moiya, 3.ii.49.

Remarks. The spiculation of the several specimens shows the usual variation in

size. The main interest lies, however, in the external form. The smallest specimens, 10 to 15 mm. diameter, have the spherical or subspherical shape typical of the species, but in one or two cases these small spherical sponges have coalesced to give an irregular lobulated mass. In the larger specimens, 50 to 60 mm. across, on the other hand, the form is often extremely irregular, suggesting not only the coalescence of several smaller sponges but irregularities of growth due to environmental factors.

Distribution. Red Sea; Indian Ocean; Malay; Australasia; Antarctic.

Chondrilla sacciformis Carter

(For synonymy *see* Burton, 1924.)

Occurrence. Sherm-el-Moiya, 3.ii.49.

Distribution. Indian Ocean; Malay.

Chondrosia reniformis Nardo

Chondrosia reniformis Nardo, 1847: 272.

Occurrence. Abu Zabad, 11.ii.49.

Remarks. The two specimens appear to be typical except that there is a sparse accumulation of fine sand grains in the outer layers of the cortex.

Distribution. Atlantic coast of Europe; Mediterranean; South Africa (Stil Bay); Indian Ocean; Malay; Australia.

Chrotella cavernosa (Lamarck)

Tethya cavernosa Lamarck, 1813: 70; 1815: 385.
T. cranium var. *australiensis* Carter, 1886: 127.
Cinachyra australiensis, Burton, 1934: 523.
(For further synonymy *see* Burton, l.c.)

Occurrence. Mualla, 30.i.49, at low tide under rocks.

Distribution. Red Sea; Indian Ocean; Malay; Australia; Philippines.

Tethya aurantium (Pallas)

(*See* Burton 1924 and 1949: 122.)

Occurrence. Sherm Sheik, 2.ii.49, 11.i.49, and 2.ii.49; Tiran, 10.i.49; Mualla, 30.i.49, at low tide under rocks.

Remarks. The five specimens, all somewhat flattened, are fawn, orange, or red (in formalin) and measure 7, 8, 12, 18, and 21 mm. across respectively.

Distribution. Arctic; North Atlantic; West Indies; Mediterranean.

Tethya robusta Bowerbank

(For synonymy *see* Burton, 1924.)

Occurrence. Mualla, 30.i.49, under rocks at low tide; Abu Zabad, 10 and 11.ii.49, on reef at low tide.

Remarks. The six specimens measure 13, 15, 21, 25, 26, and 28 mm. across respectively. The colour (in formalin) is pink to red. There is, however, another specimen

consisting of five lobes set in a horizontal plane, each lobe being about 20 mm. across. Its colour was a cerise-red in formalin. Clearly this specimen has been formed by the complete coalescence of five adjacent individuals. It is not unknown for two specimens to fuse in this way, but five is unusual.

The spiculation is typical in all but two specimens, which lack the larger micrasters. In other words, these two should be assigned to *Tethya japonica* Sollas. In 1924 I suggested that this so-called species was probably a reduced form of *T. diploderma* Schmidt (= *T. ingalli* Bowerbank), but it now seems that it is a mixture of the reduced forms of both *T. robusta* and *T. ingalli*.

Distribution. Australia; Malay; Indian Ocean.

Pseudosuberites mollis Topsent

Pseudosuberites mollis Topsent, 1925: 9, fig. 2*m*.

Occurrence. Mualla, 30.i.49, under rocks at low tide.

Remarks. The sample consists of three fragments of a soft and delicate sponge, having approximately the characters described by Topsent (l.c.). The spicules are slightly larger, 0·15 to 0·45 by 0·005 to 0·008 mm., as compared with 0·175 to 0·315 by 0·0065 mm. in the holotype, but the variations in the shape of the spicules are similar to those figured by Topsent.

Distribution. Mediterranean (Étang de Thau).

Haliclona toxophorus (Hentschel)

Gellius toxophorus Hentschel, 1912: 392, pl. xxi, fig. 46.
G. toxotes, idem, l.c.: 392, pl. xxi, fig. 47.

Occurrence. Sherm Sheik, 11.i.49.

Remarks. The two small fragments are evidently from one sponge which formed a flattened, massive incrustation, with oscules slightly raised. Almost transparent, soft and compressible, delicate in texture, the specimen appears to be denuded of flesh, the skeleton, an isodictyal and unispicular network, being held together by spongin at the nodes. The megascleres are oxea, with a tendency to become strongylote at one or both ends, 0·24 by 0·012 mm. The microscleres are toxa, 0·02 to 0·1 mm. across.

The two species described by Hentschel were sufficiently closely related, judging by the original descriptions, to suggest their identity one with the other. The intermediate character of the present material adds point to this.

Distribution. Malay.

Adocia dendyi (Burton)

Toxochalina robusta Dendy, 1905: 139; idem, 1921: 29.
T. dendyi Burton, 1931: 340, fig. 2*b*.
Nec *Toxochalina robusta* Ridley.

Occurrence. Sherm Sheik, 11.i.49.

Remarks. The several specimens are all small and cushion-shaped, with conspicuous oscules 2 to 3 mm. diameter. The colour, in spirit, is brownish grey, and

the texture soft, compressible, elastic. The main skeleton is a close-meshed reticulation of fibres, the ascending fibres multispicular (3 to 4 spicules), the connectives unispicular. The tangential dermal skeleton is very much as figured by me (l.c., fig. 2*b*) and is unispicular. The spicules are oxea 0·1 by 0·004 mm., and toxa of about the same length.

Distribution. Indian Ocean.

Callyspongia viridis (Keller)

Dactylochalina viridis Keller, 1889: 391, pl. xxiii, figs. 37–43.

Occurrence. Sherm Sheik, 2 and 3.ii.49; Tiran, 10.i.49; Abu Zabad, 10 and 11.ii.49, on reef at low tide; Dahab, 13.i.49 and 14.ii.49; Sanafir, 4, 5, and 6.ii.49.

Remarks. Of the eleven specimens, only one is almost identical with that figured by Keller (l.c., fig. 37), nine of the remainder being irregularly massive, on the whole smaller, and the eleventh being no more than a thin incrustation on a coral. All have the typical vents and the typical pore-sieves (Keller, l.c., fig. 40), although in some cases the pore-sieves are less strongly marked. In a few cases, at least, the characters of the surface have been blurred by preservation in formalin.

The characters of the skeleton are comparatively uniform for the nine irregularly, massive specimens, but the typical specimen and the thin incrustation show features which merit special notice. In the nine specimens the network of the main skeleton consists of well-marked primary or ascending fibres which branch, as they run to the surface, in a somewhat irregular manner. At the centres of the fibres is a more or less continuous core of spicules arranged in an untidy manner (almost irregularly sub-plumose), often with individual spicules projecting from the fibres. The primary fibres are connected by secondary fibres, thinner than the primaries, and forming often an irregular network. In these the spicules are arranged, usually, uniserially; but, again, individual spicules may project, at right angles to the main series, beyond the surface of the fibres. The tangential skeleton at the surface is a close-meshed network of fibres, cored by uniserially arranged oxea, and showing no obvious differentiation into primary and secondary meshes. The average diameter of the meshes is 0·04 mm. The oxea vary from 0·08 to 0·16 by 0·004 to 0·005 mm.

The main skeleton of the one typical specimen (i.e. externally typical) is unlike that of the nine specimens in that it approaches the ceraochalinoid condition. It is a very close-meshed reticulation of thick fibres which appear at first sight to be aspiculous. In general it resembles that shown in Keller's fig. 39. On closer examination, however, it can be seen that the spicules are present, are reduced in numbers, and seldom more than 0·002 mm. thick; and often a spicule may be discontinuous throughout its length (as though breaking up).

As a result of comparing the external forms of these sponges, as well as the structure of their skeletons, there seems little doubt that they are all conspecific and that the variation in their skeletons is unimportant. Generally speaking, it seems that in the younger sponges and the newer tissues the reticulation of the fibres is more loose and the fibres themselves more heavily cored with spicules; that with maturity the skeleton is more closely knit and the proportion of spicule to spongin decreases (cf.

Burton, 1926: 265). One further point may be mentioned. In the specimen, described above as typical, the spicules have the appearance, as a result of their slender build and the discontinuous structure already referred to, of being dissolved or absorbed. Whether, in fact, this is the case is, however, problematical.

The colour of the present specimens, in formalin, was grey to fawn.

Distribution. Red Sea.

Gelliodes fibulatus Ridley

Gelliodes fibulatus Ridley, 1884: 427, pl. xxxix, fig. 1, pl. xli, fig. *b*; Ridley & Dendy, 1887: 47, pl. xii, fig. 2; Lendenfeld, 1887: 793.
Pachychalina fragilis, Lindgren, 1897: 481; idem, 1898: 290.
Gelloides ramosa Kieschnick, 1898: 47.
? *Pachychalina conulosa*, idem, l.c.: 51.
Gelliodes ramosa, idem, 1900: 565, pl. xliv, fig. 3.
? *Pachychalina conulosa*, idem, l.c.: 568, pl. xliv, fig. 8.
Gelliodes fibulatus, Hentschel, 1912: 393.
Sigmaxynissa fibulata, Burton, 1928: 115.

Occurrence. Graa, 30.i.49; Sherm-el-Moiya, 3.ii.49; Sanafir, 6.ii.49.

Remarks. It is somewhat surprising to find what appear to be typical examples of this species so far west as the Gulf of Aqaba. All records previously have been for the Malay region and the Indian Ocean (Andaman Islands).

Distribution. Malay; Indian Ocean; (? Australia).

Mycale euplectellioides Row

Esperella euplectellioides Row, 1911: 333, pl. xxxvii, fig. 12, text-fig. 16.
Mycale euplectellioides, Burton, 1926: 80.

Occurrence. Sherm Sheik, 2.ii.49; Graa, 30.i.49; Dahab, 13.i.49; Sanafir, 4 and 6.ii.49.

Remarks. The sponge occurs in irregular masses on coral, the largest being some 30 mm. across. Externally there is a close resemblance to the type, and from the condition of the several specimens, when removed from the formalin in which they were originally preserved, it is clear that a copious amount of mucus is present in life.

The skeleton is typical except that microscleres are extremely rare, none being found except in a section from one specimen, which contained a few sigmata, 0·05 to 0·08 mm. chord, and one anisochela 0·024 mm. chord.

Distribution. Red Sea; Suez Canal.

Mycale (Carmia) suezza (Row)

Esperella suezza Row, 1911: 338, fig. 18.

Occurrence. Mualla, 31.i.49; Dahab, 14.ii.49.

Remarks. Two samples are assigned doubtfully to this species. The first is a thin incrustation, orange-coloured in formalin, and a larger, irregularly massive sponge, having the same colour and general appearance. The skeleton has the same structure as the holotype of *Mycale suezza*, but in neither specimen has it been possible to find a single microsclere.

Distribution. Red Sea.

Mycale (Aegagropila) erythraena (Row)

Esperella erythraena Row, 1911: 340, fig. 19.
Mycale erythraena, Burton, 1926: 80.

Occurrence. Dahab, 4.ii.49.

Remarks. The single specimen forms a thin, irregular incrustation on coral. Its colour, in formalin, was grey. The arrangement of the skeleton approximate closely to the type, and the megascleres are typical in form and size; but in spite of repeated searching not a single microsclere has been found.

Distribution. Red Sea; Suez Canal.

Genus ***PARISOCIELLA*** gen. n.

Type Species. Esperiopsis anomala, Ridley & Dendy, 1886: 341.

Diagnosis. Mycaleae with skeleton an irregular reticulation of spongin fibres cored by slender tylostyli; microscleres, when present, degenerate anisochelae palmatae and toxa.

Parisociella anomala (Ridley & Dendy)

Esperiopsis anomala Ridley & Dendy, 1886: 341; idem, 1887: 84.
Ceraochalina gibbosa Keller, 1889: 386, pl. xxiv, fig. 44.
Ophlitaspongia arbuscula Row, 1911: 347, pl. xxxix, fig. 22, pl. xl, fig. 25, text-fig. 22.
O. horrida, idem, l.c.: 349, pl. xl, fig. 26, text-fig. 23.

Occurrence. Sanafir, 4 and 9.ii.49, along the shore among rocks; Abu Zabad, 10.ii.49, on reef at low tide.

Diagnosis. Sponge typically branching, surface uneven, minutely hispid; oscules not apparent; texture soft, elastic; colour alive red, in spirit greyish yellow to dark grey; main skeleton an irregularly isodictyal reticulation of fibres cored by megascleres; dermal skeleton of radiating brushes of megascleres; megascleres tylostyli, slender and often appearing as styli, 0·25 to 0·3 by 0·002 to 0·005 mm.; microscleres usually absent and never plentiful, anisochelae palmatae, 0·01 mm. chord, and toxa, 0·02 to 0·06 mm. long.

Remarks. The diagnostic features of this species are unsatisfactory, since the microscleres, even when present, exist in such small quantities and are difficult to find. Further, the main skeleton is so like that of *Mycale euplectellioides*, growing in the same habitat, that only the external form remains as a guide to identification. If, therefore, the particular specimen is macerated or fragmentary the possibility of wrong identification is great.

The present three specimens include a fragment of a branch, which is macerated, and two extensive, but low, incrustations on pieces of coral. The colour, in formalin, was orange and yellowish brown, in spirit, yellow or brown. No microscleres were found.

Distribution. Red Sea; Honolulu.

Lissodendoryx cratera (Row)

Myxilla cratera Row, 1911: 343, pl. xxxvii, fig. 13, text-fig. 20.

Occurrence. Abu Zabad, 11.ii.49.

Distribution. Red Sea.

Agelas mauritianus (Carter)

Ectyon mauritianus Carter, 1883: 310, pl. xii, fig. 3.
Agelas mauritianus, Ridley & Dendy, 1887: 164, pl. xxix, fig. 10.
A. cavernosa Thiele, 1903: 963, fig. 28.
A. mauritiana, Dendy, 1905: 174.

Occurrence. Sanafir, 6.ii.49.

Remarks. A fairly large fragment which, in formalin, was pink outside and orange in the interior.

Distribution. Indian Ocean; Malay.

Halichondria glabrata Keller

Halichondria glabrata Keller, 1891: 311, pl. xvi, fig. 9; Burton, 1926: 75.

Occurrence. Abu Zabad, 11.ii.49.

Remarks. A single, thinly encrusting specimen, in colour pale brown, both in formalin and in spirit.

Distribution. Red Sea.

Rhaphoxya typica Hallmann

Rhaphoxya typica Hallmann, 1917: 643, pl. xxix, fig. 3, pl. xxxviii, figs. 8–9, pl. xxxix, fig. 5, pl. xlii, figs. 1–2, text-fig. 17.

Occurrence. Sanafir, 6.ii.49; Abu Zabad, 10.ii.49, on reef at low tide.

Remarks. The several species which may be assigned to *Rhaphoxya* are mainly Australian and none has been previously recorded from the Red Sea, although *Anacanthaea nivea* Row might conceivably belong to this genus. Yet the present two specimens clearly belong to *Rhaphoxya* and are almost certainly conspecific with the genotype. They are both encrusting, but their general appearance and the characters of the surface agree closely with those described and figured by Hallmann, except that the pore-areas (?), in his pl. xxxviii, fig. 8, are not so numerous in the 'Manihine' sponges. There is, also, a close agreement in the shape of the spicules and their arrangement in the skeleton, except that the trichites are not numerous and, as far as can be seen, do not form dragmata.

A striking feature of the anatomy concerns the presence of numerous oval groups of cells, looking very like embryos, which they may well be, except that they vary somewhat in size, from 0·08 to 0·2 mm., with 0·12 mm. as the average, across the long axis. The tissues of the sponge contain numerous brown pigment cells in the surface layers, and the 'embryos' lying in the surface tissues are also filled with them.

Disiribution. Australia.

Order KERATOSA

Aplysilla lacunosa Keller

Aplysilla lacunosa Keller, 1889: 356, pl. xxii, figs. 19–22.

Occurrence. Sanafir, 6.ii.49.

Remarks. A single, very small, incrusting specimen, purple in colour, showing the typical fibres (see Keller, l.c., pl. xxii, fig. 22).

Distribution. Red Sea.

Megalopastas erectus Row

Megalopastas erectus Row, 1911: 360.

Occurrence. Sherm Sheik, 11.i.49; Dahab, 14.ii.49.

Remarks. The two specimens form irregular encrustations, with the surfaces irregularly conulose. The colour of one, in formalin, was purple, in spirit it turned to a deep violet; in the other it was fawn in formalin and the same in spirit.

Distribution. Red Sea.

Spongia officinalis Linnaeus, var. ***arabica*** (Keller)

Euspongia officinalis, var. *arabica* Keller, 1889: 342; Topsent, 1906: 558; Row, 1911: 379.

Occurrence. Abu Zabad, 10 and 11.ii.49, on reef at low tide; Sherm-el-Moiya, 3.ii.49; Sanafir, 9.i.49.

Remarks. There are two typical specimens, two very small specimens in which the skeleton only remains and which are doubtfully assigned to this species, a fifth, typical but very small, and a sixth specimen which agrees in general appearance, but has the internal tissues so crowded with sand that a better identification is not possible.

The colour in formalin varies from fawn (the specimens without flesh) to dark brown.

Distribution. Red Sea.

Heteronema erecta Keller

Heteronema erecta Keller, 1889: 340, pl. xx, figs. 4, 7, 8; Topsent, 1906: 558; Row, 1911: 369.
Duriella nigra Row, 1911: 370, pl. xli, fig. 29.

Occurrence. Dahab, 3.i.49 and 2.ii.49 and 14.ii.49, shore; Sanafir, 5.ii.49.

Remarks. The type of *Duriella nigra* and Row's specimen of *Heteronema erecta* are almost identical in external form though they differ in the structure of the skeleton. Both specimens are, however, massive and lack the digitiform processes of the type of *H. erecta.* There is also available in the British Museum collection a preparation from Keller's type, and comparing this with Row's specimens suggested, in the first place, that the only difference between *Duriella nigra* and *Heteronema erecta* lay in the much greater amount of sand in the fibres of the latter. The 'Manihine' specimens, four in all, have a sufficiently general resemblance to each other, and to the specimens described by Keller and Row, to be considered alongside them. In these, two have a skeleton approximately similar to that of *Duriella nigra*, one is much more like *Heteronema erecta*, and the fourth is intermediate between the two.

With seven specimens thus available for comparison it seems certain that the variation in the skeleton of this species (for *Duriella nigra* and *Heteronema erecta* are here accepted as conspecific) is similar to that shown by me (1934, figs. 18–33) for *Dysidia fragilis.* In other words, that according to the amount of sand present the skeleton will vary from clearly defined ascending fibres cored with sand, connected by a secondary network free of it, to a dense network in which the spongin of all fibres is almost entirely obscured by a heavy intake of sand, with no perceptible differentiation into primary (or ascending) and secondary fibres.

Supporting such a view is the fact that the amount by which the fibres are impregnated with sand varies from one part to another of the skeleton of any individual sponge.

The colour of the 'Manihine' specimens ranged, in formalin, from brown to a deep purple-brown.

Distribution. Red Sea.

Carterispongia clathrata (Carter)

(For synonymy and discussion *see* Burton, 1934: 574.)

Occurrence. Sherm Sheik, 11.i.49; Mualla, 31.i.49; Dahab, 13 and 14.ii.49; Sanafir, 9.i.49 and 4.ii.49; Sherm-el-Moiya, 3.ii.49.

Remarks. The several fragmentary specimens have the typical cavernous appearance. The skeleton differs considerably, however, from one individual to another, and these differences seem to offer a gradation from the typical skeleton of this species to that of *Euryspongia lactea*. It is possible, therefore, that *Euryspongia* may ultimately prove to be synonymous with *Carterispongia*.

The colour of the different specimens, in formalin, ranged from fawn or brown, to purple, with occasional pink patches.

Distribution. Indian Ocean; Australia; (? West Indies).

Hircinia ramosa Keller

Hircinia ramosa Keller, 1889: 345, pl. xx, fig. 5.
H. schulzei Dendy, 1905: 221, pl. xvi, fig. 3.
H. ramosa, Row, 1911: 372; Burton, 1934: 579, pl. 1, fig. 11, text-fig. 16.

Occurrence. Sanafir, 8.i.49 and 9.ii.49, littoral, growing among rocks.

*Remarks.*The two specimens are typical in the structure of the skeleton but show less of the ramose external form. One of them is low-lying and massive, with occasional ramose portions.

The colour of the two specimens, in formalin, was fawn and brown respectively, in spirit it is now olive-green and brown.

Distribution. Red Sea; Ceylon; Australia (Barrier Reef).

Cacospongia ridleyi, sp. n

Cacospongia cavernosa Ridley, 1884: 590; nec *C. cavernosa*, Autt.

Occurrence. Abu Zabad, 11.ii.49.

Remarks. The name *Cacospongia cavernosa* has been used by many authors for sponges from the Indian Ocean, Mediterranean, and the West Indies. Pallas (1766: 395) appears to have been the first to use the trivial name, but his *Spongia cavernosa* is not recognizable except as one of the Keratosa. Esper's (1794: 189) *S. cavernosa*, based on Pallas's specimen, has been inadequately re-described by Ehlers (1870: 30); and Lamarck's specimen (1813: 371) has been shown by Topsent (1930: 13) to be conspecific with *Ciocalypta penicillus* Bowerbank. Ridley (1884: 590) recorded specimens under *Cacospongia cavernosa* from the Seychelles, and it is with these

that the present specimens are to be identified. *C. ridleyi* agrees closely with *C. cavernosa* Schmidt (as re-described by Schulze, 1879) in external form, but the skeleton has larger meshes and the fibres are more heavily cored with sand-grains and other foreign bodies. It is, however, impossible to say, in the present state of our knowledge, whether the sponges from Seychelles and the Gulf of Aqaba represent a simple variety of the Mediterranean form. As a temporary measure at least they are here given full specific rank.

Distribution. Indian Ocean.

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IV. TURBELLARIA: POLYCLADIDA

By STEPHEN PRUDHOE

THOUGH comprising only three specimens, the collection is an interesting one, since it includes three species which apparently have not been recorded hitherto from the Red Sea.

The condition of the material is satisfactory, and it has been possible to supplement existing descriptions of the three species with some new details of their structure, more especially of the copulatory organs.

Lastly, a brief historical account of the polyclad fauna of the Red Sea is given, together with a list of the species recorded.

PLANOCERIDAE

Planocera crosslandi Laidlaw, 1903

(FIG. 1)

A young adult specimen of this species was found in the fauna associated with coral at Sherm Sheik, 2 February. It measures about 28 mm. in length and about 20 mm. in maximum width, which occurs in the middle region of the body.

FIG. 1. *Planocera crosslandi.* Arrangement of eyes (dorsal view).

In the structure of the copulatory organs the present specimen agrees very well with the original description of *P. crosslandi*. The posterior region of the cirrus-cavity bears three very large hook-like structures, one of which is attached to the dorsal wall and the others to the subventral walls of the cavity. These structures are directed posteriorly and lie almost entirely in the spacious male antrum.

Planocera crosslandi has been recorded hitherto only from British East Africa.

Leptoplanidae

Notoplana gardineri (Laidlaw, 1904)

(Fig. 2)

A single individual, provisionally assigned to this species, was found under a rock near the low-tide mark at Sherm Sheik, 15 February. Unfortunately the specimen is damaged, and, as a portion of its hinder region is lost, it is not possible to determine the structure of the female copulatory apparatus.

Transverse serial sections of the copulatory organs of the type-specimen of this species have recently been presented to the British Museum (Natural History) by

Fig. 2. *Notoplana gardineri*. Arrangement of eyes (dorsal view).

Dr. F. F. Laidlaw. The series is incomplete, but, so far as it has been possible to make out, the male copulatory apparatus of the specimen from the Red Sea is indistinguishable, structurally and histologically, from that of the type-material of *N. gardineri* (Laidlaw), a species known hitherto only from Ceylon.

The damaged specimen is somewhat pellucid and measures about 16 mm. in length and about 9 mm. in maximum width. The body is more or less oval in outline. No tentacles have been made out. The eyes are arranged in two elongate groups (Fig. 2). Those in the hinder region of each group are distinctly larger than the remainder and probably represent the tentacular eyes present in other species of *Notoplana*.

The mouth occurs about 10 mm. from the anterior extremity of the body and opens into the hinder region of the pharyngeal chamber. The latter measures about 4·5 mm. in length and contains about 10 pairs of shallow lateral pockets.

The male pore is situated at 3·5 mm. behind the mouth. As is usual in this genus, the ovaries and testes lie in the dorsal and ventral parenchyme respectively. The vasa deferentia unite to open into the proximal end of the arcuate seminal vesicle, which possesses a very thick coat of longitudinal and circular muscle-fibres. This vesicle opens, through the ejaculatory duct, into a well-developed, somewhat pear-shaped prostatic organ lying above the proximal end of the seminal vesicle. The ejaculatory duct projects well into the prostatic organ, the highly glandular epithelium of which completely invests the duct. In this epithelium there are seven elongate pockets, which, together with the ejaculatory duct, open into a small chamber situated in the posterior region of the prostatic organ. From the prostatic chamber a long ductus communis or prostatic canal passes through an extremely thick sheath of muscle-fibres and enters a very small penis-papilla lying in the shallow male antrum. The thick sheath appears to be a continuation of the musculature of the prostatic organ and merges with that of the penis-papilla. There are numerous nuclei present among the muscle-fibres of the sheath, and they seem to congregate more particularly around the prostatic canal.

N. gardineri appears to bear a very close resemblance to *Notoplana otophora* (Schmarda, 1859) which was also originally recorded from Ceylon. According to Stummer–Traunfels (1933), the 'ductus communis' or prostatic canal of the type-specimen of *N. otophora* is invested with a deep layer of parenchymatous tissue enclosed in a thick muscular sheath. On the other hand, in *N. gardineri* the prostatic canal is, as stated above, invested solely with an extremely thick musculature of longitudinal and circular fibres. Nuclei are abundant in this musculature, being particularly dense immediately around the prostatic canal. This difference between the two species might be accounted for by the fact that the type-specimen of *N. otophora* had, when examined by Stummer–Traunfels, apparently been stored in preserving fluid for about seventy years. During this time the tissues of the specimen had, no doubt, undergone some maceration and possibly the histology of the structure through which the prostatic canal passes might originally have been similar to that occurring in *N. gardineri*. In other respects, except possibly in the number of eyes, the two species appear to be identical.

Notoplana cotylifera Meixner, 1907

A single specimen was found in sponges associated with coral at Graa, 30 January. It agrees very well with the description of *N. cotylifera* Meixner, and, as in the original material, a well-developed sucker occurs between the genital pores.

The most striking feature of the female copulatory apparatus in this species is

the pocket-like structure, which Meixner regards provisionally as a rudimentary accessory vesicle, opening into the vagina interna, near the 'shell'-chamber. A somewhat similar structure occurs in the present specimen, but in this instance it appears also to open on the dorsal surface of the body, anteriorly to the female genital pore. Unfortunately the condition of the tissues in this region of the body is not very satisfactory, and the presence of a dorsal opening requires confirmation. If a study of new material were to show that the dorsal opening normally occurred in this species, the accessory structure of the female apparatus would appear comparable with the ductus vaginalis present in some other species of Polyclads.

Notoplana cotylifera has been recorded previously from the Gulf of Tadjoura, French Somaliland, which is, of course, situated near the southern entrance to the Red Sea. Thus the occurrence of this species in the Gulf of Aqaba is not unexpected.

The history of the Polyclad fauna of the Red Sea apparently begins in the year 1826, when the name *Planaria mülleri* was given by Audouin to a planarian figured, but not described, by Savigny in the same year. Two years later (1828) Leuckart described five new forms from Tor in the Gulf of Suez. This work was shortly followed by that of Ehrenberg (1831), in which a further four new species were described from Tor and the Isle of Ras el Gusr. The descriptions of all these ten species are very incomplete, and it does not appear possible to recognize any of the species with certainty.

After 1831 no further species of Polyclads seem to have been recorded from this region until Boutan (1892) mentioned the occurrence of *Pseudoceros violaceus* (Schmarda) at Port Tewfik. Another thirty years elapsed before Meyer (1922) described three new species from Kosseir. Since the appearance of Meyer's work, Palombi (1928) has recorded, among other species, *Idioplana australiensis* Woodworth[1] from the Port of Suez, and Melouk (1940, 1941) has described two new forms from the Biological Station at Ghardaqa.

The results of the sporadic work done since 1826 indicate that our knowledge of the occurrence and distribution of Polyclads in the Red Sea is, in all probability, very incomplete. It may therefore be deemed useful to tabulate the species, including those in the present collection, that have so far been recorded from the Red Sea. The taxonomy of some of the species is very uncertain, and these are marked with an asterisk in the following table:

Species	*Locality*
Cestoplana polypora Meyer, 1922	Kosseir
'*Craspedomata* sp. ?' Palombi, 1928	Gulf of Suez
Cryptophallus aegyptiacus Melouk, 1940	El Ataka & Ghardaqa
**Eurylepta flavomarginata* Ehrenberg, 1831	Ras el Gusr
**Eurylepta praetexta* Ehrenberg, 1831	Tor
Idioplana australiensis Woodworth, 1898	Port of Suez
**Leptoplana hyalina* Ehrenberg, 1831	Tor
[This species, the type of the genus *Leptoplana*, has been regarded by most early writers as a synonym of *Leptoplana tremellaris* (Müller, 1774).]	

[1] Judging from Palombi's description, the material determined by him as *Idioplana australiensis* is probably not identical with that described by Woodworth. In fact, Palombi's material appears to be more closely related to the genus *Idioplanoides* Barbour, 1912, than to *Idioplana* Woodworth, 1898.

Species	*Locality*
Leptoplana nadiae Melouk, 1941	Ghardaqa
Notoplana cotylifera Meixner, 1907	Graa
Notoplana gardineri Laidlaw, 1903	Sherm Sheik
Paraplanocera marginata Meyer, 1922	Kosseir
**Planaria bilobata* Leuckart, 1828	Tor
**Planaria bituberculata* Leuckart, 1828	Tor
**Planaria gigas* Leuckart, 1828	Tor
**Planaria limbata* Leuckart, 1828	Tor
**Planaria mülleri* Audouin, 1826	——
[*P. bituberculata* and *P. mülleri* have been generally regarded as synonyms of *Stylochus suesensis* Ehrbg. If this be accepted, *P. mülleri* has priority over *S. suesensis* and therefore becomes the type-species of *Stylochus* Ehrbg.]	
**Planaria zebra* Leuckart, 1828	Tor
Planocera crosslandi Laidlaw, 1903	Sherm Sheik
Pseudoceros violaceus (Schmarda, 1859)	Port Tewfik
Stylochus coseirensis Bock, 1927 [*nom. nov.* pro *Stylochus reticulatus* of Meyer, 1922]	Kosseir
**Stylochus suesensis* Ehrenberg, 1831	Tor & Port of Suez

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V. GEPHYREA

By A. C. STEPHEN

ROYAL SCOTTISH MUSEUM

THROUGH the courtesy of the British Museum (Natural History), I have had the privilege of examining this collection. It is a small one containing seven individuals, referable to two genera of Sipunculids and one Echiurid. With one exception they have been recorded previously from the Red Sea, the exception being *Siphonosoma koreae* Satô, whose status is discussed.

ECHIURIDAE

Ochetostoma erythrogrammon (Leuckart & Rüppell)

Sherm Sheik, 15.ii.49. Under rock at low tide. One specimen, body 30 mm., proboscis 22 mm.

This species has already been recorded from a number of localities in the Red Sea.

SIPUNCULIDAE

Siphonosoma koreae Satô

Sherm-el-Moiya, 3.ii.49. Associated with coral. One specimen, not fully extended, 115 mm. in length.

A single specimen, which agrees closely with Satô's description (Satô, 1939: 379), was secured. The body is long and thin, pink in colour, and capped at both ends by areas of yellow colour, the posterior area being much less extensive than the anterior area. The body is translucent, the muscle-bands showing through clearly.

The posterior end of the body is somewhat cone-like, and the yellow cap extends for a distance of 5 mm. The introvert is not fully extended, but the yellow area occupies some 20 mm. of the body.

In the specimen described by Satô the colour of the body is given as greyish white.

The skin has numerous papillae, prominent and closely packed on the posterior end and at the base of the introvert, small and scattered on the rest of the body.

Satô described the papillae on the posterior end in his specimen as being less prominent than those on the introvert basis. In this specimen, however, they are of similar size. On the introvert basis the area of prominent papillae extends for about 4 mm.

On the introvert the papillae are small and arranged on circular ridges.

The longitudinal muscle is divided into 19 bands, as in Satô's specimen.

This species was described by Satô from a single specimen taken at Gunzan in Korea on 2 September 1937. In his key and text it is described as being very similar to *S. cumanense* (Keferstein), separable mainly by colour differences, especially the yellow caps, and by the character of the papillae on the basis of the introvert. The

specimen from Aqaba differs from the Korean one in the colour of the body and the greater prominence of the posterior papillae. In view of the somewhat protean nature of *S. cumanense*, with its three well-marked and widely distributed varieties, of which two are common to both the Red Sea and Korean waters, as well as the differences between the two known specimens, it is possible that more material may show that it is not a distinct species but only another variety of *S. cumanense*.

Physcosoma pacificum (Keferstein)

Abu Zabad. 11.ii.49. On reef at low tide. Two specimens. One partially extended, 12 cm. in length. The other similar in size but much contracted. Greyish brown in colour, with scattered darker patches.

Tiran. 10.i.49. Associated with coral. One large specimen; not fully extended, about 13 cm. in length. Uniformly greyish brown in colour with a number of darker bands anteriorly.

Dahab. 3.ii.49. Shore. Two specimens of similar size to the above, but too contracted for measurement. Greyish brown in colour, with scattered darker patches.

This species is widely distributed in the Indo-Pacific area and has already been recorded from the Red Sea.

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VI. MOLLUSCA

By W. J. REES *and* A. STUCKEY

THE mollusca are represented by 2 Loricates, 27 Gastropods, 13 Lamellibranchs, 4 Cephalopods, and a few Nudibranchs not reported on here. As this particular area has been thoroughly worked for mollusca by numerous workers, notably McAndrew and Issel, it is not surprising that no new forms were found. The Gastropoda and Lamellibranchia call for no special description and have been listed with notes on distribution. Although the Cephalopoda are all well-known species, they are so well preserved that we have noted features of interest, standard measurements, and included photographs.

Callistochiton heterodon var. *savignyi* appears to be rare and is only known from the northern part of the Red Sea; it was not hitherto represented in the collections of the British Museum. Other species which appear to be confined to the Red Sea are *Clanculus pharaonis*, *Trochus erythraeus*, and *Lithophaga hanleyana*. All the remaining species are found either in the western part of the Indian Ocean or have a wide distribution in the Indo-Pacific. In the Cypraeidae Schilder (1938) has drawn attention to races of well-known species which are becoming differentiated in various areas, including the Red Sea.

The classification of Indian Ocean Lamellibranchs, and indeed all Lamellibranchs, is in a very unsatisfactory state, and in the specific names we have adopted we have followed Thiele (1929–1934), Tomlin (1927), Smith (1897), and various papers by E. Lamy. Recent work on molluscs has shown that species seemingly identical, or appearing to have only minor points of difference, have distinct larvae and life histories, revealing that they are distinct. Elaborate lists of synonyms may therefore prove erroneous, and usually we have confined ourselves to referring the specimens to species with which they appear to be identical.

Among the Cephalopods *Octopus macropus* is common in the Red Sea and in the Mediterranean. The remainder, *O. horridus* Orbigny, *O. cyanea* Gray, and *Sepioteuthis lessoniana* Lesson, are at the western limit of their range, which extends to the Andaman Islands in *O. horridus* and throughout the tropical Indo-Pacific in the other species.

The Cephalopods of the Red Sea have been reviewed by Adam (1942) and a study of his list reveals that they are all either littoral and shallow water forms or have planktonic larvae which live close to the surface during their early life.[1] As examples of the former we have species of *Octopus*, *Sepia*, *Sepioteuthis*, and *Doryteuthis*, and of the latter (oceanic species) we have *Symplectoteuthis*, *Tremoctopus*, and *Argonauta*. Cephalopods characteristic of deep water, and even the Cranchiidae (pelagic species which spend much of their early life in the upper 500 metres), are absent.

It has been pointed out by Thompson (1939) that there is a shallow sill near

[1] We have excluded *Spirula spirula* (L.), the shells of which are recorded from the Red Sea. It is probable that these have their origin outside the area.

Hanish Islands separating the Red Sea 'proper' from the Gulf of Aden. At about latitude 13° 41′ N. the depth of the sill is only 100 metres, and this may act as a geographical barrier to deep-water species. This is probably one reason why bathypelagic forms are absent in the Red Sea, but it does not explain the absence of Cranchiidae, which as larvae often occur right up to the surface. The normal interchange of water over the sill (see Thompson) should carry the larvae into the Red Sea and another explanation is required. There are some grounds for believing that these forms are the young of little known bathypelagic species and they may not be tolerant to high salinities of 38‰ to 40‰ such as are typical of the Red Sea.

The following species are known only from the Red Sea; those marked by an asterisk are insufficiently known and may prove to belong to other species:

Sepia savignyi Blainville, 1827
**Sepia gibba* Ehrenberg, 1831
**Sepia elongata* Férussac & d'Orbigny, 1835–1848
**Sepia trygonina* Rochebrune, 1884
Doryteuthis arabica Ehrenberg, 1831
**Abralia steindachneri* Weindl, 1912
Octopus robsoni Adam, 1941
Sepia dollfusi Adam, 1941

Four of the above are imperfectly known, and of the seventeen species recorded from the Red Sea, only four sound species can be regarded as endemic. It is possible that even this number may be further reduced when the cephalopod fauna of the western Indian Ocean becomes better known.

Class LORICATA

Family Crytoplacidae

Callistochiton heterodon var. ***savignyi*** Pilsbry

Locality: 30.i.49, Mualla, 1 specimen.

This small Callistochiton was taken with two specimens of *Acanthopleura haddoni*. It has a total length of 13 mm. and a breadth of 7·5 mm.

This variety was named by Pilsbry (1892) from a figure given by Savigny (*Egypte*, pl. 3, fig. 8). Our specimen has the following characters. Shell oval, distinctly ridged along the median line; the sides of the valves are only slightly curved. Valves greyish white with occasional irregular darker markings. Girdle buff-coloured with faint slate-grey vertical bands. Head valve, with 10 slightly denticulate ribs, 2 of these bifurcate anteriorly. Tail valve, distinctly narrower than head valve, with 11 radiating rays. Other valves with distinct but not backward projecting beaks. Lateral areas raised with 2 denticulate ribs. Central areas with 7–8 narrow deeply etched riblets on each side with a central smooth tract between them.

This variety has affinities with *C. adenensis* Smith, but differs from it mainly in having only 10–11 radiating ribs on the anterior valve instead of 22 as in Smith's species. *C. heterodon* var. *savignyi* is only known from this northern part of the Red Sea.

Family Chitonidae

Acanthopleura haddoni Winckworth

Acanthopleura sp. Haddon, 1886: 24.
Chiton (*Acanthochites*) *spiniger* Issel, 1819: 235 [non Sowerby].
Acanthopleura spinigera, Sykes, 1907: 34; Tomlin, 1927: 292 [non Sowerby].
Acanthopleura haddoni Winckworth, 1927: 206.

Localities: 29.xii.48, Aqaba, just below low tide mark, 4 adults. 8.i.49, Sanafir, 2 adults. 30.i.49, Mualla, attached or under stones at low tide, 2 adults. 9.ii.49, Sanafir, among rocks along the shore, 1 adult.

This large and decorative chiton is known from the Suez area of the Red Sea under the name *spinigera*. The earliest record is that of Savigny (*Egypte*, pl. 3, fig. 4). Winckworth (1927) distinguishes the species from *A. spinigera* Sowerby, an Australian and Indonesian species, and described specimens from Aden under the name *A. haddoni*. According to Winckworth the living animal reaches a length of 3 in. and our largest specimen is of this size, although it cannot be measured accurately because of contraction of the foot causing the animal to be bent in the form of a crescent. In all our examples the girdle is irregularly marked with black and olive bands. In the living animal the foot is of a salmon-pink colour.

It is impossible at present to give an accurate picture of the distribution of this mollusc. We know it occurs in the Red Sea (at Aden, Suez, and the localities given above), but its occurrence outside this area becomes confused with that of *A. spinigera* (Sowerby). Cyril Crossland (quoted by Sykes) notes that it is 'the common high tide chiton, everywhere in E. Africa, on the cliffs of coral-rag at Djibouti, Mombasa, Zanzibar, Wasin etc.; also on stone on the edge of reefs of the East Coast of Zanzibar'.

Class CEPHALOPODA

Family Loliginidae

Sepioteuthis lessoniana Lesson (Plate 28, figs. 1 and 2; Plate 29, figs. 5 and 6)

31.xii.48, Station A1, dip net, surface, Faraun Island, 1♀(3). 28.i.49, Aqaba, 1♀(1). 4.ii.49, Sanafir, cast net, surface, 1♂(2).

The two specimens are remarkably well preserved, and the ground colour in formalin is flesh-coloured. The reddish-purple chromatophores are fairly evenly distributed over the ventral surface of the head, arms, funnel, and mantle, with denser patches around the edge of the eye. There are no chromatophores on the ventral surface of the fins; the muscle-fibres of the fins are prominent.

On the dorsal surface, the chromatophores are more densely crowded, especially just above the eye, and on the dorsal mantle.

In the male (less prominent in the female) there are irregular ivory-coloured patches which are covered by one or more large chromatophores. When the skin of the mantle is folded back to expose the pen, these white patches are seen to lie over patches of bright emerald-green, which presumably cause the animal to be iridescent. The secondary sexual character of the male (transverse whitish streaks across the dorsal mantle), which has been noted by Adam (1938), is distinct in the

large male from Sanafir (No. 2). Colour notes on the living animal state that the dorsal mantle was of a reddish-brown colour with iridescent green spots on the mantle itself, but not on the fins. The animals appear to fall within the limits given by Adam (1939) in his review of *Sepioteuthis lessoniana*. Adam, and indeed most other workers, have given figures of medium-sized individuals of about 150 mm. in dorsal mantle length. In these the maximum fin width is found in the posterior third of the body, but in our specimens, which are much larger, the maximum fin width occurs about midway between the apex and the mantle margin. This is to be expected in the larger animals because growth proceeds at a much faster rate in the posterior third of the body. As far as can be judged from Adam's illustrations of *S hemprichii* Ehrenberg 1831 our specimens agree in form of the body and in the fins. There appears to be no doubt that Ehrenberg's specimens were really large individuals of *S. lessoniana* like these from the Gulf of Aqaba. The hectocotylized arm (left ventral arm) is particularly well developed and of the usual pattern in *Sepioteuthis*. There are 34 pairs of suckers which gradually diminish in size distally, with a proportionate increase in size of their peduncles. The distal portion of the arm is occupied by 25 pairs of triangular flattened papillae. As noted by Adam (1939) the papillae on the dorsal side are more strongly developed than those on the ventral side.

In the female specimen spermatophores have been deposited on the ventral side of the buccal membrane.

TABLE I

Sepioteuthis lessoniana Lesson

(Measurements in mm.)

	(1) ♀	(2) ♂	(3) ♀
Dorsal mantle length	280	270	136
Ventral mantle length	260	235	127
Greatest mantle length	65	80	35
Greatest mantle thickness	60	63	34
Length of head	39	61	31
Width of head	64	71	36
Thickness of head	45	46	23
Length of fin	258	246	124
Distance between fin base and mantle margin	5	6	6
Arms			
1st right	72	87	30
1st left	69	80	28
2nd right	102	111	47
2nd left	39 (broken)	105	51
3rd right	128	131	58
3rd left	64 (broken)	122	60
4th right	122	136	62
4th left	66 (broken)	134	62
Length, right tentacle	197	214	95
Length, left tentacle	71 (broken)	244	92
Right tentacular club	110	101	40
Left tentacular club	(missing)	116	42
Diameter largest arm sucker	5	5	2·5
Diameter largest tentacular sucker	7	8	4

Sepioteuthis sp. (Plate 29, figs. 3 and 4)

1.ii.49, Sherm Sheik, surface, 1 juvenile. 11.i.49, Sherm Sheik, 1 newly hatched.

The young post-larval squid compares very favourably with one illustrated by Wülker (1913, pl. 22, fig. 2*g*). In our specimen the chromatophores are more numerous than in Wülker's slightly younger specimen. Full measurements of this specimen are given in Table II. We are not able to assign this to any particular species of *Sepioteuthis*, but if we may judge by the extent to which the fins are developed there is every likelihood that it is a young individual of *Sepioteuthis lessoniana* Lesson.

The newly hatched larva has a dorsal mantle length of only 4·5 mm. and is a little damaged. It compares very favourably with a stage illustrated by Wülker in his figure 2*g*.

TABLE II

Sepioteuthis sp.

(Measurements in mm.)

Dorsal mantle length			19
Ventral mantle length			17
Greatest mantle breadth			7
Greatest mantle thickness			6·5
Length of head			7
Width of head			7
Thickness of head			6
Length of fin			12
Distance between fin base and mantle margin			5
Arms	*Right*	*Left*	
1st	3·5	3·5	
2nd	7	7	
3rd	10	10	
4th	8	8	
Length, right tentacle			16
Length, left tentacle			16
Right tentacular club			7·5
Left tentacular club			7·5
Diameter of largest arm sucker			0·35
Diameter of largest tentacular sucker			0·4

Octopus horridus d'Orbigny (Plate 29, fig. 7)

Octopus horridus d'Orbigny, 1826: 144.
Octopus argus Krauss, 1848: 132.
Polypus aculeatus Hoyle, 1904: 194 [non d'Orbigny 1840].
Octopus (*Octopus*) *horridus*, Robson, 1929: 91.

10.i.49, Tiran, found in coral, 1 ♂.

This littoral octopus is well known from the Suez area of the Red Sea. It has been previously taken in the crevices of coral by Hoyle (1907).

Our specimen agrees in most particulars with earlier descriptions, but a few features are worthy of comment. The dorsal surface of the mantle, head, and arms is ornamental with pale olive-green patches; most of these have a distinct cirrus in the

centre. The spaces in between the paler patches are filled by closely grouped chromatophores, which appear black or very dark red in formalin. There is no ocellus. The ventral surface of the mantle is of a pale cream colour. Colour notes on the living animal state that when found the *Octopus* was yellowish with a green network on the arms. The ground colour changed to brown when the animal was placed on a dark background.

The ground colour of the inner surface of the tentacles is also pale cream with light brown chromatophores evenly distributed over it.

The body is ovoid, the eyes prominent, and the arms long in proportion to the length of the body (the arms are too tightly coiled for accurate measurements, but the formula is of the order 4.3.2.1). The ventral arms are more robust than the others, the first pair being the least well developed. As noted by Robson (1929) the hectocotylized arm is shorter than its fellow. The spermatophore groove on the ventral side is prominent, and is protected especially near its tip by a membraneous extension of the arm.

The standard measurements are given in Table III.

Distribution. This species has been recorded by a number of workers, from the Red Sea, and especially from the Suez Canal zone (see Robson, 1929). Beyond the Red Sea it has been recorded from Ceylon, and other parts of the central Indian Ocean by Hoyle (1904, 1905, 1907*a* and *b*). Other records from the same area are given by Robson (1929: 91). There are no records of this species east of the Andaman Islands.

TABLE III

Octopus horridus d'Orbigny

(Measurements in mm.)

Sex	♂
Total length (including 3rd arm)	65+
Dorsal mantle length	15
Width of body	12
Width of head	11
Arm formula	4.3.2.1
Web formula	$D > C = E > B > A$
Diameter of largest sucker	2·25
Length of ligula	2·55
Indices	
Mantle width index	**80**
Head width index	**13·5**
Sucker index (normal)	**15**

Octopus macropus Risso

11.ii.49, Abu Zabad, on reef at low tide, 1 ♀. 31.xii.48, Station A1, Faraun Island, surface, imm. ♂.

This well-known octopus needs no further description, but standard measurements are provided for comparison with those which already exist for the Caribbean population of this species (Table IV). The measurements indicate that the Red Sea specimens fall within the limits already known for the species.

Distribution. The species occurs in the Caribbean, the NE. Atlantic, the Mediterranean, the Red Sea, and the Indo-Pacific to Japan and Australia. Its eastern limit appears to be the Marshall Islands. It has been recorded from the Red Sea by Wülker (1920) and Weindl (1912), to mention only two records.

Table IV

Octopus macropus Risso

(Measurements in mm.)

Sex		♀			juvenile ♂	
Total length (including 3rd arm)		246			40	
Dorsal mantle length		58			16	
Eye to dorsal web		47			6	
Width of body	36	36			10	
Width of head	—	29			7	
Arms	*Right*		*Left*	*Right*		*Left*
1st	246		245	34		34
2nd	228		227	28		26
3rd	208		177	23		22
4th	186		190	20		20
Diameter of largest sucker	—	6			0·75	—
No. of gill filaments		—			11	
Web formula		$B > A > C > D > E$			$B > C = A = D > E$	
Indices						
Mantle width index		**62**			**62·5**	
Head width index		**50**			**44**	
Sucker index (normal)		**10·5**			**4·7**	
Arm length index		**78·5**			**68**	

Table V

Octopus cyanea Gray

	I		*II*	
Sex	♀		♀	
Total length (including longest arm)	420		343	
Dorsal mantle length	52		55	
Eye to dorsal web	—		44	
Width of body	46		38	
Width of head	40		35	
Arms		*Right*		*Left*
1st	—	265		205*
2nd	—†	280		190
3rd	—	200*		260‡
4th	—	190‡		210‡
Diameter of ocellus	8		5	
Diameter of largest sucker	6		5	
No. of gill filaments	7–8		9	
Web formula	—		$D = C > B > A = E$	
Arm formula	—		2.1.3.4 or 1.2.3.4	
Web depth	—		47	

* Arm incomplete, tip portion missing. † Arms too tightly coiled for accurate measurements.
‡ Regenerating.

Indices

Mantle with index	88·5	69
Head width index	77	63·5
Sucker index (normal)	11·5	9·1
Arm length index	82	81·5
Web depth index	—	16·8

Octopus cyanea Gray (Plate 30)

Octopus cyanea Gray, 1849: 15.
Octopus marmoratus Hoyle, 1886: 227.
Octopus horsti Joubin, 1898: 23.
Polypus fontanianus Robson, 1920: 437.
Polypus horsti, Wülker, 1920: 51.

6.i.49, Sanafir, along shore, 1 ♀. 12.i.49, Sherm Sheik, in shallow water along shore, 1 ♀.

We have referred these two specimens to *Octopus cyanea* Gray, but as they present a different appearance to what is usually associated with *O. cyanea*, the various features worthy of note are discussed below. Typical specimens, of which we have seen a number in the collections of the British Museum, are, as Robson says, 'mainly of a warm ochreous red suffused and maculated with purple, which may be very deep so as to render the animal homogeneously blackish or deep livid (in preservative)'. Our specimens, however, are of a buff or pale brownish colour, with an olive-green sheen, which is especially marked on the dorsal surface of the web and the base of the tentacles. The top of the head, between the eyes, is a deeper brown colour. The specimens are paler ventrally and the ventral side of the arms have the characteristic zebra-like marking which Robson regards as one of the most striking and constantly associated features of *cyanea* as a species. Colour notes made from the living animal state that the colour of the specimen taken on 12.i.49 was brown and that the zebra-like markings on the arms were of a light blue colour.

The dark purple ocellus is well marked and surrounded by an ill-defined pale ring, as mentioned by Robson for his British Museum specimens (Nos. 4 and 8).

Specimen No. I is rather contracted; the skin of the mantle is reticulated and has a number of scattered irregularly arranged cirri, which are more numerous between the eyes and on the fore part of the head. Specimen No. II is less contracted, and has four cirri arranged in a diamond pattern on the dorsal mantle and four to five prominent cirri on the fore part of the head. The ventro-lateral and anterior portion of the mantle carries a number of scattered cirri. There is also a curious fold of skin, on either side of the neck region postero-ventral to the eye, which effectively separates the ventral funnel region from the lateral face of the head.

The dorso-lateral surface of the arms in both specimens have a double row of slightly raised, buff-coloured, simple papillae which have not been mentioned by any other writer. A re-examination of Gray's type of *O. cyanea* and other specimens reveals the presence of these papillae, but they are more difficult to see than in our specimens, because they are obscured by the dark, ground colour normal in this species.

The number of gill filaments in the demi-branchs, normally a good diagnostic feature in octopods, appears to be rather variable in the species (7–9 in our specimens). Robson gives 9–10 for Gray's type of *O. cyanea*, and we have found that even in the same specimen one gill may have 7 filaments and the other 9 filaments per demi-branch (1 ♀ from the Cocos-Keeling Islands).

Standard measurements are given in Table V, but it has not been possible to give measurements of the arms in specimen I because they are too tightly coiled.

The only other ocellate species recorded from this area is *Octopus robsoni* Adam, 1941, of which a complete description has not yet been published. Adam states that this octopod 'se caractérise à première vue par la présence d'une paire d'ocelles pourvue d'un anneau irisé blanchâtre, bleuâtre ou mauve'. We have mentioned this species because our specimens approach nearer to it in colour and the arrangement of the cirri than to the typical form usually found in *O. cyanea*. However, the character of the ocellus, without an iridescent ring, the zebra-like markings on the ventral surface of the arms, and the various indices which fall within the limits of *O. cyanea*, leaves us in no doubt as to the identity of our species.

Distribution. *Octopus cyanea* is a littoral species well known as a reef-inhabiting octopod, with a distribution ranging through the Indo-Pacific in tropical and subtropical waters from Hawaii to the Red Sea.

Previous records from the Red Sea are given by Robson (1929) and Wülker (1920).

Class GASTROPODA

Family HALIOTIDAE

Haliotis varia L.

31.xii.48, station A1, shore of Faraun Island, 3 specimens. 20.i.49, Dahab, on mud flats at low tide, 1 specimen. 5.ii.49, Sanafir, found on coral, 1 specimen. 11.ii.49, Abu Zabad, on reef at low tide, 4 specimens. 15.ii.49, Sherm Sheik, under rocks at low tide, 1 specimen and 1 juvenile. Dahab, found on coral, 1 specimen.

Issel (1869) collected two specimens of *H. varia* from the Gulf of Suez. From the numbers obtained in our collection it appears to be fairly common in the Gulf of Aqaba. According to Pilsbry (1890) it has a wide distribution in the Indo-Pacific, being found in the following places: Australia and Philippines to China; Mozambique, Red Sea, Island of Bourbon, Mauritius, Ceylon, Nicobar Islands, Malay Archipelago.

Family FISSURELLIDAE

Diodora ruppellii (Sowerby)

Fissurella ruppellii Sowerby, 1838: 128.
Fissurella costaria Vaillant, 1865: 109.
Fissurella vaillanti Fischer, 1865: 244.
Glyphis ruppellii, Pilsbry, 1890: 217, pl. 39, fig. 8.
Diodora ruppellii, Tomlin, 1927: 289.

15.ii.49, Sherm Sheik, under rock at low tide, 1 specimen.

Distribution. This molluscs seems to be common almost throughout the Suez

Canal according to Tillier & Bavay. It has frequently been reported at Suez (see Tomlin, 1927, for previous records). *D. ruppellii* is found in the Western Indian Ocean, in the Red Sea, at Aden, Mauritius, and on the East African coast.

Family PATELLIDAE

Cellana rota (Gmelin)

Patella rota, Issel, 1869: 233.
Patella rota, McAndrew, 1870: 444.
Patella variegata Reeve, 1842, pl. 136, fig. 1.
Cellana rota, Tomlin, 1927: 299.

12.i.49, Sherm Sheik, 6 specimens. 20.i.49, Dahab, on mud flats at low tide, 2 specimens.

Both McAndrew and Issel record this species as common; the former from the Gulf of Suez and the latter from the Gulf of Aqaba. Tomlin (1927) found it in the Suez Canal zone.

Distribution. Red Sea, east coast of Africa, Réunion, and Madagascar.

Family TROCHIDAE

Clanculus pharaonis (L.)

30.i.49, Mualla, among rocks and coral at low tide, 1 specimen.

This is one of the most characteristic molluscs of the Red Sea area; it occurs from Suez to Aden, and was reported by Issel (1869) to be especially common in the Gulf of Aqaba. Tomlin (1927) gives previous records for the Suez area and records it from the Canal.

Trochus (Infundibulops) erythraeus Brocchi

20.i.49, Dahab, on mud flats at low tide, 1 specimen. 2.ii.49, Sherm Sheik, associated with coral, 2 fms., 1 specimen.

T. erythraeus has been collected from the Gulf of Aqaba by Issel (1869). Tomlin (1927) recorded it from the Gulf of Suez, and various other collectors, e.g. McAndrew (1870) and Vaillant (1865), have recorded it from the Red Sea area.

Trochus dentatus Forskål

30.i.49, Mualla, among rocks and coral at low tide, 2 specimens. 2.ii.49, Sherm Sheik, associated with coral, 1 young specimen.

T. dentatus is one of the common molluscs of the Red Sea and Persian Gulf. It has been recorded from the Gulf of Suez by McAndrew, Issel, and Vaillant. Tomlin (1927) reports it from the Suez Canal zone, and Issel (1869) states that it is abundant in the Gulf of Aqaba.

Family TURBINIDAE

Turbo radiatus Gmelin

6.ii.49, Sanafir, found in coral, 1 specimen. 11.ii.49, Abu Zabad, on reef at low tide, 2 specimens.

T. radiatus is a common Indo-Pacific form, which is found in the Red Sea, the East African coast, and eastwards as far as the Philippines and New Caledonia. Tillier & Bavay (1905) and Tomlin (1927) record it from the Gulf of Suez and the Suez Canal zone.

Family NERITIDAE

Nerita forskalii Recluz

6.i.49, Sanafir, along shore of anchorage, 3 specimens. 12.i.49, Sherm Sheik, 7 specimens. 30.i.49, Mualla, found at low tide among rocks and coral, 2 specimens.

This extremely variable mollusc has been recorded from the Gulf of Aqaba by Tomlin (1927) and Issel (1869). It is a common Indo-Pacific form, Tryon (1888) giving its distribution as the Red Sea, Indian Ocean, Natal, Singapore, China, the Philippines, and Viti Islands.

Nerita undata var. ***quadricolor*** Gmelin

12.i.49, Sherm Sheik, 1 specimen.

N. undata is a widely distributed species in the Indo-Pacific. In the variety *quadricolor* the aperture of the shell is white and the ribs are maculated with purplish black. This variety is confined to the western part of the Indian Ocean.

Family PLANAXIDAE

Planaxis breviculus Deshayes

6.i.49, Sanafir, along shore of anchorage, 3 specimens.

This species has been reported from the Gulf of Suez by McAndrew (1870), who records it as a common species at low water. Smith (1891) reports it from Aden and refers to specimens in the British Museum from the Gulf of Aqaba and Persian Gulf. According to Tryon (1887) *P. breviculus* is a variety of *P. sulcatus*. Both forms have a wide distribution in the Indo-Pacific. Until more is known about the life-history of these periwinkles, we prefer to retain the name *P. breviculus*.

Family CERITHIIDAE

Cerithium tuberculatum (L.)

6.i.49, Sanafir, shore of anchorage, 2 specimens.

McAndrew found this species moderately common in the Gulf of Suez. It is an extremely variable species, and has been reported on numerous occasions from the Red Sea.

Distribution. Widespread in the Indo-Pacific (Smith, 1903).

Family Melanellidae

Melanella sp.

10.i.49, Tiran, 1 specimen.

We do not feel justified in giving this specimen a name in view of the confusion which exists in the classification of the genus.

Family Strombidae

Pterocera lambis (L.)

5.ii.49, Sanafir, in coral, 1 specimen.

This large shell was previously recorded from the Gulf of Aqaba by Issel (1869). *Distribution.* Widespread in the Indo-Pacific.

Family Naticidae

Natica mamilla L.

N. mamilla, Lamarck, 1838: 630.

6.i.49, Sanafir, along shore of anchorage under rocks, 1 specimen.

N. mamilla has been previously recorded from the Gulf of Aqaba by Issel (1869). Tryon (1886) gives the distribution as the East Indies, the Philippines, New Caledonia, and central Polynesia.

Family Cypraeidae

Cypraea caurica (L.)

20.i.49, Dahab, on mud flats at low tide, 1 young specimen.

Schilder (1938) recognizes seven races of this species, which has a widespread distribution in the Indo-Pacific.

Cypraea arabica L.

30.i.49, Mualla, among rocks and coral at low tide, 1 specimen. 5.ii.49, Sanafir, found in coral, 1 juvenile specimen. 11.ii.49, Abu Zabad, on reef at low tide, 1 specimen. 11.ii.49, Abu Zabad, on reef at low tide, 4 juvenile specimens.

C. arabica is a well-known Indo-Pacific species, often recorded by workers on Red Sea fauna. Savigny (*Egypte*) gives a figure, and the species is recorded from the Gulf of Aqaba by Issel (1869). Schilder (1938) recognizes six races in the Indo-Pacific; our specimens conform to the E. African and Red Sea form which Schilder calls *immanis*.

Cypraea isabella L.

Turia (*Basilitrona*) *isabella*, Schilder, 1938: 176.

3.ii.49, Sherm-el-Moiya, associated with coral, 1 specimen. 6.ii.49, Sanafir, associated with coral, 1 specimen.

C. isabella, of which four races are recognized by Schilder, has a widespread distribution in the Indo-Pacific. Our specimens belong to the typical form which is confined to the Western Indian Ocean and the Red Sea.

Cypraea carneola L.

Cypraea (*Lyncina*) *carneola*, Schilder, 1938: 188.

11.ii.49, Abu Zabad, on reef at low tide, 3 specimens. 11.ii.49, Abu Zabad, on reef at low tide, 2 juvenile specimens.

This species is widely distributed in the Indian Ocean and also in the Pacific as far as Hawaii. Schilder recognizes four races of this species. The Red Sea form *crassa* is also found in the Gulf of Aden, Persian Gulf, and Karachi.

Cypraea erosa L.

Erosaria (*Erosaria*) *erosa*, Schilder, 1938: 137.

30.i.49, Mualla, among coral at low tide, 1 specimen.

This species has been recorded from the Gulf of Aqaba by Issel (1869). *C. erosa* has a wide distribution in the Indian Ocean and in the Western Pacific. Our specimen belongs to the typical form. Schilder (1938: 137) recognizes six races in the Indo-Pacific.

Cypraea tigris L.

Cypraea (*Cypraea*) *tigris*, Schilder, 1938: 186.

11.ii.49, Abu Zabad, on reef at low tide, 1 immature specimen.

Issel (1869) reports this species to be abundant in the Gulf of Aqaba. It has previously been reported from the Red Sea by many writers, including Ehrenberg (1831). Our specimen is not fully grown and we are unable to determine whether it belongs to the typical form. *Cypraea tigris* (*sensu lata*) is widely distributed in the Indian Ocean and in the Pacific.

Family CYMATIIDAE

Cymatium rubeculum (L.)

Tritonium (*Simpulum*) *rubeculum*, McAndrew, 1870: 434.
Triton (*Simpulum*) *rubecula*, Tryon, 1881: 12.

1.ii.49, Sherm Sheik, associated with coral, 2 specimens.

McAndrew took 2 specimens at Jubal Island in the Gulf of Suez.

Distribution. Red Sea to the Philippines.

Distortrix anus (L.)

Triton anus, Reeve II, *Triton*, pl. xii, fig. 63.

Abu Zabad, on reef at low tide, 1 specimen.

This species has been previously recorded from the Gulf of Aqaba by Issel (1869).

Family Muricidae

Drupa (Drupa) ricinus (L.)

30.i.49, Mualla, among rocks and coral at low tide, 4 specimens. 11.ii.49, Abu Zabad, on reef at low tide, 1 specimen.

Distribution. Red Sea, east coast of Africa, to Natal, Philippines, and Polynesia (Tryon, 1880: 184).

Drupa (Drupa) elata (Blainville)

2.ii.49, Sherm Sheik, 2 fms., associated with coral, 3 specimens.

This well-known inhabitant of coral reefs has a wide distribution in the Indo-Pacific. It is recorded from Aden by Smith (1891).

Family Buccinidae

Pisania ignea Gmelin

2.ii.49, Sherm Sheik, 2 fms., 1 specimen. 5.ii.49, Sanafir, found in coral, 1 specimen.

Distribution. Red Sea, Singapore, and Philippines.

Family Conidae

Conus rattus Lamarck

Conus rattus, Smith, 1891: 399.
Conus rattus, Dautzenberg, 1937.

Conus rattus is a very variable species and has been recorded by many authorities including Smith (1891) and Dautzenberg (1937). Its distribution is very widespread in the Indo-Pacific.

Conus textile L.

11.ii.49, Abu Zabad, on reef at low tide, 1 specimen.

This poisonous cone shell is widely distributed in the Indo-Pacific and has been recorded from the Gulf of Aqaba by Sturany. Dautzenberg (1937) gives a very long list of localities for the species.

Family Nassidae

Nassa pulla L.

20.i.49, Dahab, collected on mud flats at low tide, 5 specimens.

Issel (1869) records this shell from the Red Sea area. Tryon (1882) gives its distribution as the Red Sea, Java, and the Philippines.

Class *LAMELLIBRANCHIA*

Family Arcidae

Arca divaricata Sowerby

Arca divaricata, Tomlin, 1927: 304.

2.ii.49, Sherm Sheik, associated with coral, 2 fms., 2 specimens. 15.ii.49, Sherm Sheik, under rocks at low tide, 3 specimens.

It has previously been recorded by Tomlin from the Suez Canal and by McAndrew from the Gulf of Suez, under the name *A. plicata*. *A. divaricata* has a wide distribution in the Indian and Pacific Oceans.

Arca (Barbatia) decussata Sowerby

31.xii.48, station A1, shore of Faraun Island, 1 specimen. 31.xii.48, station A1, shore of Faraun Island, 2 specimens. 20.i.49, Dahab, mud flats at low tide, 4 specimens. 30.i.49, Mualla, among rocks and coral at low tide, 1 specimen. 9.ii.49, Sanafir, among rocks on shore, 1 specimen.

This species is known from the following places, according to Lamy (1917), Djibouti, Obock, Perim, and Aden. It is expected to have a much wider distribution, and we note a specimen in the British Museum collections from the Java Sea (off Batavia).

Family Mytilidae

Brachidontes variabilis (Krauss)

Mytilus variabilis Krauss, 1848: 25.
Mytilus pharaonis Tillier and Bavay, 1905: 177.
Mytilus exustus, Vaillant, 1865: 114.

20.i.49, Dahab, on mud flats at low tide, 1 specimen.

This very common species was first described from Table Bay by Krauss, who drew attention to its similarity to specimens from the Red Sea. The earliest record from the latter locality is that of Savigny (*Egypte*, pl. xi, fig. 5).

Lithophaga hanleyana Reeve

31.i.49, Mualla, associated with coral, 2 specimens.

L. hanleyana has been previously recorded from the Gulf of Aqaba by Sturany (1899), who also recorded it from the Gulf of Suez and the Red Sea generally. It has also been recorded from the Gulf of Suez by Reeve and McAndrew. The Cambridge expedition to the Suez Canal (1924) also took the species in association with coral.

Lithophaga moluccana Hanley

14.ii.49, Dahab, associated with coral, 1 specimen.

We have identified this species with Hanley's species from Malacca. It appears

to differ from *L. hanleyana* (which is already known from the Red Sea) by the more tapering posterior part of the shell.

Distribution. Indian Ocean.

Family Vulsellidae

Vulsella vulsella (L.)

V. lingatula, Issel, 1869: 99.
V. mylitina, Issel, 1869: 100.
V. trita Reeve, 1858, pl. 2, fig. 17.

14.ii.49, Dahab, associated with coral, 1 specimen.

Smith (1911), who has reviewed the genus, gives the distribution of this species as widespread in the Indian Ocean and eastwards to Japan, N. Australia, and New Caledonia. From the Red Sea it has been figured by Savigny (*Egypte*, pl. xiv, figs. 1 and 2) Rüppell records it as *mytilina* and Reeve as *trita*, both from the Red Sea.

Family Pectinidae

Chlamys luculentus (Reeve)

Pecten luculenta Reeve, 1853, pl. 16, fig. 59.

2.ii.49, Sherm Sheik, 2 fms., associated with coral, 1 specimen.

We have compared this specimen with the holotype of Reeve from NW. Australia and also with some specimens in the British Museum collection from Aden. There are no differences to be noted in our shell.

The known distribution is the Red Sea and Indian Ocean.

Family Ostreidae

Ostrea cucullata Born

9.ii.49, Sanafir, among shore rocks, 1 specimen.

O. cucullata is a very variable species and had been recorded from the Gulf of Suez by Vaillant (1865) and by Issel (1869). This oyster is edible and according to Jousseaume, as quoted by Lamy (1925), is an excellent purgative.

Distribution. Very common at many points in the Red Sea, attached to rocks, which are uncovered by the tide. This species is common throughout the Indian Ocean, and in the Pacific as far as Japanese waters (Lamy, 1925).

Family Carditidae

Cardita variegata (Sowerby)

Cardium variegatum Sowerby, 1841: 107.
Cardita subaspersa Lamarck, 1819: 25.
Cardita radula Reeve, 1843: 191.

11.ii.49, Abu Zabad, on reef at low tide, 4 specimens.

C. variegata is widespread in the Indo-Pacific, Red Sea, and Australian waters. Lamy (1916) records it from Suez, Massaouah, Djibouti, and Perim.

Family TRIDACNIDAE

Tridacna noae (Röding)

Tridacnes noae Röding, 1798: 171.
Tridacna elongata Lamarck, 1819: 106.

31.xii.48, shore of Faraun Island, 2 specimens.

This *Tridacna* has been recorded from the Red Sea, from Suez, and the Gulf of Aqaba by Issel (1869) under the name *T. elongata* Lamarck. Savigny gives the earliest figure from this area (*Egypte*, pl. x, fig. 1). It has a wide range in the Indo-Pacific, including Zanzibar, Mauritius, Australia, Solomon Islands, Carolines, Marshall, and Loo Choo Isles (McLean, 1947).

Tridacna squamosa Lamarck

One specimen of this common Indo-Pacific form was collected; the label appears to have been lost.

Distribution. Indian Ocean, Indonesia, Australia, the Philippines, and Japan.

Family VENERIDAE

Circe scripta (L.)

Venus scripta L.

20.i.49, Dahab, mud flats at low tide, 1 specimen.

Sowerby gives the distribution of this as the Red Sea and Australia. According to Issel (1869) it is a rare species at Suez.

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Legends to Plates 28–30

PLATE 28. *SEPIOTEUTHIS LESSONIANA* LESSON

FIG. 1. Ventral view of ♀ caught at the surface off Faraun Island, 31.xii.48.

FIG. 2. Dorsal view of ♂ caught off Sanafir Island, 4.ii.49.

The transverse streaks characteristic of the male and the pale areas overlying the iridescent patches are clearly shown in the photograph.

PLATE 29

FIGS. 3 and 4. *Sepioteuthis* sp.; dorsal and ventral views of a young immature specimen taken off Sherm Sheik, 1.ii.49.

FIG. 5. *Sepioteuthis lessoniana* Lesson; left tentacle club of ♀ shown on Plate 28, fig. 1.

FIG. 6. *Sepioteuthis lessoniana* Lesson; right tentacle club of ♀ taken at Aqaba, 28.i.49.

FIG. 7. *Octopus horridus* Orbigny taken at Tiran Island, 10.i.49.

PLATE 30. *OCTOPUS CYANEA* GRAY

FIG. 8. Lateral view of a ♀ taken at Sherm Sheik, 12.i.49.

FIG. 9. Oral face of the same specimen as in Fig. 8. The so-called 'zebra' markings on the lateral side of the arms are a constant feature in this species.

SEPIOTEUTHIS LESSONIANA LESSON

7

5

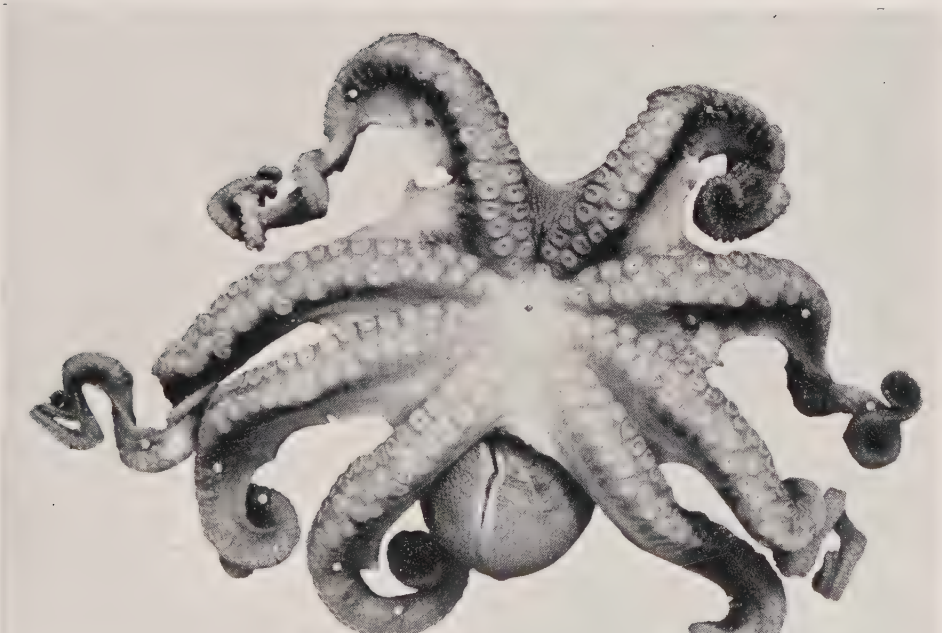
3

4

6

AQABA CEPHALOPODA

8



9

OCTOPUS CYANEA GRAY

VII. ECHINODERMATA

By AILSA M. CLARK

THE collection of Echinoderms includes many well-known littoral species which are widespread throughout the Indo-West Pacific area, as well as some which are peculiar to the Red Sea. A few species, notably the single Crinoid *Capillaster multiradiata* (Linnaeus) and an Echinoid, *Clypeaster fervens* Koehler, have not been previously recorded from the Red Sea.

The species are the following, all of them from low tide or low spring tide level except where otherwise stated. Those mentioned in more detail in the text are marked with an asterisk. References in the text giving further details are marked with a dagger.

	Locality	*Number*
ASTEROIDEA		
Astropecten polyacanthus Müller & Troschel	Dahab	1
	Ras Muhammad Bay	1
**Fromia ghardaqana* Mortensen	Dahab	1
	Abu Zabad	3
**Gomophia egyptiaca* Gray	Abu Zabad	1
Linckia multifora (Lamarck)	Sherm Sheik	2
	Dahab	1
	Sanafir I.	1
Asterope carinifera (Lamarck)	Abu Zabad	2
**Asterina burtonii* Gray	Sanafir I.	1
	Dahab	1
	Sherm Sheik	1
	Abu Zabad	4
OPHIUROIDEA		
**Ophiocoma pica* Müller & Troschel	Dahab	5
	Sherm Sheik	4
	Sanafir I.	5
	Mualla	1
	Tiran	3
	Abu Zabad	5
**Ophiocoma scolopendrina* (Lamarck)	Sanafir I.	3
	Dahab	8
	Faraun Id.	10
	Sherm Sheik	4
	Abu Zabad	2
**Ophiocoma erinaceus* Müller & Troschel	Dahab	2
	Sherm Sheik	1
	Sanafir I.	2
	Abu Zabad	2
Ophiocoma valenciae Müller & Troschel	Tiran	4
	Sanafir I.	1
	Sherm Sheik	1
	Abu Zabad	2
	Dahab	1
**Ophiocoma* sp.	Sherm Sheik	1
**Macrophiothrix hirsuta* (Müller & Troschel)	Sherm Sheik	1
	Sanafir I.	1
	Dahab	2

	Locality	Number
Ophiotrichoides propinqua (Lyman)	Dahab	2
**Placophiothrix purpurea* (von Martens)	Dahab	1
Ophiolepis cincta Müller & Troschel	Dahab	5
	Abu Zabad	2
	Sherm Sheik	3

CRINOIDEA

**Capillaster multiradiata* (Linnaeus)	Dahab	1

ECHINOIDEA

Eucidaris metularia (Lamarck)	Sherm-el-Moiya	1
	Mualla	2
	Sherm Sheik	8
	Sanafir I.	2
	Tiran	7
Diadema setosum (Leske)	Aqaba	2
	Sherm-el-Moiya	1
	Tiran	1
	Faraun I.	1
	Abu Zabad	1
Echinometra mathaei (Blainville)	Mualla	1
	Abu Zabad	4
	Sherm Sheik	4
	Tiran	5
	Sanafir I.	4
	Dahab	10
Heterocentrotus mammillatus (Linnaeus)	Dahab	3
**Tripneustes gratilla* (Linnaeus)	Abu Zabad	3
	Sanafir I.	1
	Dahab	6
	Aqaba	2
Clypeaster humilis (Leske)	Dahab	1
**Clypeaster fervens* Koehler	Dahab	1
Lovenia elongata (Gray)	Dahab	1

HOLOTHUROIDEA

Synapta maculata (Chamisso & Eysenhardt)	Um Nageila (in shallow water off mangrove swamp)	1
Synaptula recta (Semper)	Sherm Sheik	1 (pt.)
Halodeima edulis (Lesson)	Dahab	1
	Abu Zabad	1
Halodeima atra (Jäger)	Abu Zabad	2
Halodeima cinerascens (Brandt)	Abu Zabad	1
Holothuria impatiens (Forskål)	Dahab	5
**Holothuria sucosa* Erwe	Dahab	1
Holothuria pardalis (Selenka)	Dahab	5
	Graa	2
Holothuria curiosa var. *pervicax* (Selenka)	Dahab	1
Microthele difficilis (Semper)	Abu Zabad	8
	Dahab	6
**Microthele nobilis* (Selenka)	Ras Muhammad Bay	1
Actinopyga miliaris (Quoy & Gaimard)	Faraun I.	1

ASTEROIDEA

Family Linckiidae

Fromia ghardaqana Mortensen

Pl. 31, Figs. *a–c*

Scytaster milleporellus, Müller and Troschel, 1842: 35; [non *Asterias milleporella* Lamarck, 1816: 564].
Fromia milleporella (part), Gray, 1866: 14.
Fromia monilis, Tortonese, 1935: 70; 1936: 213; [non *Fromia monilis* Perrier, 1875: 443 (p. 179 in repaged edition)].
Fromia ghardaqana Mortensen, 1938: 37.

Dahab, shore; 1 specimen. Abu Zabad, reef at low water springs; 3 specimens.

Description. R = 40 mm., r = 10 mm., R/r = 4·0. The arms taper evenly throughout their length to a rather pointed tip. One has been broken and is in process of regeneration. Of the five primary inter-radial plates, three are enlarged with a flat surface raised slightly above the level of the surrounding plates, the one adjacent to the madreporite is smaller but also a little elevated, while the fifth is not at all conspicuous. The madreporite is triangular in shape, with deep radiating grooves, and measures 1·4 mm. across.

The carinal row of plates is not very clear proximally, where all the plates are in fact rather irregularly arranged. At the base of the arm there are about seven plates across the width.

All the dorsal and ventral plates, as well as the marginals, are closely covered with uniform, smooth, rounded granules, about 7 in the length of 1 millimetre. These lie very close together and are polygonal on the convex plates, of which there are about 10 on the dorsal side of each arm, besides the primary inter-radial plates and the marginals. Most of the convex plates are near the tip of the arm, but an irregular series of spaced plates occupies the mid-radial distal area.

The number of supero-marginal plates varies between 19 and 21 on the four complete arms, with the same number in each infero-marginal series. The latter plates are relatively narrower and are noticeably longer than broad. In the distal half of the arm they may bear a small tubercle in the centre as also do the last two superomarginals. These plates, unlike the infero-marginals, are not evenly sized but, especially distally, large and small plates tend to alternate with one another, the larger ones being rather convex. The two series of marginal plates tend to alternate in position.

On the ventral side the papulae are clearly visible in the angles between the plates. The granules surrounding each one are not markedly larger than the other granules. Proximally there are 3 rows of papulae, correlated with the presence of 4 rows of ventro-lateral plates. The outermost row of these consists of only 4 plates on each side of the interbrachial angle, extending to the aboral end of the second inferomarginal plate. The third series reaches the seventh infero-marginal, the second to the eleventh plate, and the innermost series to the fourteenth.

The adambulacral plates bear 2, or, in the middle part of the arm, often 3 flattened furrow spines. Outside these is a single stumpy spine, shorter than the furrow spines though much thicker and slightly elongated in transverse section. On both sides of this spine and outside it are numerous granules like those of the ventro-lateral plates.

Remarks. Müller and Troschel's description of *Scytaster milleporellus* together with the locality of the Red Sea suggests that their specimens like many of Gray's were almost certainly *Fromia ghardaqana.* However, some of the latter, from Mauritius and other localities in the Indian Ocean, are the form (pl. 31, fig. *d*) with even-sized supero-marginal plates which is generally assumed to represent *Fromia milleporella.* Since Lamarck gave as the type locality 'les mers d'Europe?', and only a brief description, it is not certain which form really is *milleporella.* This question can only be answered by study of the type specimens if they are still in existence.

Mortensen has examined the type of *Fromia monilis* Perrier and finds it quite distinct from the Red Sea species, although he does not give any details.

On comparison of the specimen described with one of *F. monilis* from Macclesfield Bank, South China Sea, with R = 35 mm., it is at once seen that the granulation of the dorsal side of the latter is very much finer with at least 10 granules to a millimetre rather than only 7. Also the arms of *F. monilis* are relatively much narrower with R/r about 4·5 on average and the supero-marginal plates usually occupy more of the dorsal surface of the arm, so that only 3 or 5 rows of plates, rarely more, lie across the base of the arm. On the ventral side the granules around the pores are clearly enlarged unlike those of *F. ghardaqana.*

Unfortunately there are no specimens of *Fromia pacifica* H. L. Clark (the species that Mortensen says is most nearly related to *F. ghardaqana*) in the British Museum to compare with the material from the Red Sea. That Torres Strait species apparently has even-sized supero-marginal plates and pointed granules rather than flat ones.

There are also three juvenile specimens in the present collection, the two larger ones having R = 18 mm., but whereas one is much more slender with an R/r ratio of 3·5:1, the other has the ratio only 2·8. Of the many old dry specimens in the British Museum, the R/r value varies between 3·0 and 3·7, although a co-type of *F. ghardaqana* from Ghardaqa sent by Dr. Mortensen has the ratio 4·0. This it seems is just about the maximum value.

From all the other species of *Fromia*, *F. ghardaqana* is easily distinguished by the alternate large and small distal supero-marginals.

Gomophia egyptiaca Gray

Pl. 32

Gomophia egyptiaca Gray, 1840: 286. H. L. Clark, 1921: 55.
†*Scytaster aegyptiacus*, Perrier, 1875: 428 (p. 164 in re-paged edition).
Nardoa aegyptiaca, de Loriol, 1891: 30. Fisher, 1906: 1087. Koehler, 1910: 157, pl. xvii. 5, 6.

Abu Zabad, reef at low water springs; one specimen.

R = 84 mm., while the type has R = 62 mm. The intermarginal plates in the arm angle are not more conspicuous than in the type and indeed are quite hidden by the granulation in one of the angles.

Range. Red Sea, Mauritius, Samoa, Philippines, Fiji, Macclesfield Bank.

Family Asterinidae

Asterina burtonii Gray

Asterina burtonii Gray, 1840: 289. †G. A. Smith, 1927: 641.
Asteriscus wega Perrier, 1869: 102.
Asterina wega Perrier, 1876: 238 (p. 318 of re-paged edition).

Sanafir; one specimen. Dahab; one 6-armed specimen. Abu Zabad; 4 specimens. Sherm Sheik; one 7-armed specimen.

Remarks. Since in 1876 Perrier corrected the error in his original description of *A. wega*, regarding the number of spines on each ventro-lateral plate, emending it to 2 or 3 rather than 1, there seems to be no reason why specimens with up to 8 arms should not be regarded as *Asterina burtonii.* Smith accepts 6-armed specimens as such. These forms with more than 5 arms are usually juvenile and more or less obviously in process of regeneration. The 7-armed specimen in the present collection has 4 arms diminutive. Perrier states that all his thirteen specimens of *A. wega* were undergoing regeneration.

2. OPHIUROIDEA

Family Ophiocomidae

Ophiocoma pica Müller & Troschel

Ophiocoma pica Müller & Troschel, 1842: 101. H. L. Clark, 1921: 127, pl. xiii, 8 (coloured). †Ely 1942: 54, pl. xii, B.i., text-fig. 15.
Ophiocoma lineolata Müller & Troschel, 1842: 102. de Loriol, 1893: 28.

Dahab; 5 specimens. Sherm Sheik; 4 specimens. Sanafir; 5 specimens. Mualla; 1 specimen. Tiran; 3 specimens. Abu Zabad; 5 specimens. All from coral at low tide.

Remarks. These specimens are easily distinguished from the other Ophiocomas collected by the conspicuous stripes on the otherwise black arms and the yellowish stripes on the disk. The ratio of arm length to the disk diameter varies between 3·6 and 4·8 : 1.

Note. It has been accepted for a very long time that *O. pica* and *O. lineolata* are synonymous, but both names have been retained by different authors. For instance Koehler (1922*a*: 324) still uses *lineolata* although most other recent authors prefer *pica*. However, the latter name had page priority in Müller & Troschel's *System der Asteriden.* So in spite of its previous use in manuscript by Valenciennes, which has no validity, the name *Ophiocoma lineolata* should be dropped.

Ophiocoma scolopendrina (Lamarck)

Ophiura scolopendrina Lamarck, 1816, **2:** 544.
†*Ophiocoma scolopendrina*, de Loriol, 1893: 23. H. L. Clark, 1921: 125, pl. xiii. 9. †Koehler, 1922*a*: 325, pls. lxxiii. 5; lxxiv. 1–7.

Sanafir; 3 specimens. Dahab; 8 specimens. Faraun Island; 10 specimens. Sherm Sheik; 4 specimens. Abu Zabad; 2 specimens. All from the shore under stones.

Remarks. The colour ranges from variegated bluish grey to dense black on the dorsal side of the disk and arms, the ventral side of the disk being always pale. Most have the arms broken but they are usually relatively long, six or more times the disk diameter.

Ophiocoma erinaceus Müller & Troschel

Ophiocoma erinaceus Müller & Troschel, 1842: 98. †de Loriol, 1893: 21. H. L. Clark, 1921: 127. †Ely, 1942: 52, text-fig. 45, pl. xii*a*.

Dahab: 2 specimens. Sherm Sheik; 1 specimen. Sanafir; 2 specimens. Abu Zabad: 2 specimens.

Remarks. Except for the two specimens from Abu Zabad, these are densely black all over; even the tentacles of those from Dahab are black; also the arms are relatively short, the ratio of arm length to disk diameter being 4–4·8:1. The Abu Zabad specimens are also densely black dorsally but are pale on the underside of the disk, although the tentacles are black. The arms of one are all broken but in the other their length is nearly seven times the disk diameter. They are thus intermediate between *O. scolopendrina* (with relatively long arms and lighter colour) and *O. erinaceus*, with shorter arms and a uniformly dark colour, so there was some doubt as to which species they should be. Finally they were referred to the latter species for the following reasons: besides the very dense black colour on the dorsal side, the disk granulation hardly extends below the periphery and there are two tentacle scales for quite a large part of the arm, as in *erinaceus*. Also, apart from these morphological characters, the fact that they were taken well out on the reef at low spring tide level in the same zone as *Ophiocoma pica* suggests that they belong to *erinaceus*, for H. L. Clark makes the distinction of habitat of the two forms *scolopendrina* and *erinaceus* an important reason for maintaining them as separate species, the former characteristically occupying a higher level on the shore which is uncovered at ordinary low tides.

I fully agree with Ely that very rarely can several characters be used to distinguish intermediate specimens as belonging to one or the other species. Quite often conflicting results are obtained by using two different characters. For instance there is a specimen in the British Museum collection from Muscat, with the proportions 170 mm./21 mm. = 6·4:1, which would on this count be called *scolopendrina*, but the unrelievedly black colour on the contrary suggests that it is *erinaceus*. In such cases only a detailed observation of the habit and habitat can produce a conclusive identification.

Ophiocoma sp.

Sherm Sheik; 1 specimen.

This is a very small specimen (disk diameter = 5 mm.) with all the arms broken and a hole through the centre of the disk. It is nearest to *O. pica* as there are 2 tentacle scales, 5 slender arm spines proximally, and dark bands on the arms, also the oral shields are longer than wide. However, the dorsal side of the disk is unusual in having black spots each surrounded by a lighter ring on a dark brown background. These spots vary in size and shape but are relatively much larger than those of *Ophiocoma döderleini*.

Family Ophiotrichidae

Placophiothrix purpurea (von Martens)

Ophiothrix purpurea von Martens, 1867: 346. Döderlein, 1896: 296, pls. xiv. 12; xvii. 23.
†*Ophiothrix lepidus* de Loriol, 1893: 45, pl. xxv. 1.
†*Ophiothrix fallax* de Loriol, 1893: 47, pl. xxv. 2.
Placophiothrix purpurea, H. L. Clark, 1939: 86.

Dahab; 1 specimen.

This specimen agrees very closely with de Loriol's description of *Ophiothrix fallax* from Mauritius, as it has a pale green disk and relatively long arms (disk diameter = 4·5 mm., arm length = 45 mm.). H. L. Clark has declared *O. lepida* de Loriol to be a synonym of *O. purpurea*, from a study of the long series of specimens obtained by the John Murray Expedition. He makes no mention of *O. fallax*, but as the characters of that species are intermediate between those of the other two, it certainly comes within the range of variation of *Placophiothrix purpurea*.

Possibly Döderlein's *Ophiothrix lorioli* (1896: 297) from Amboina, with radial shields similar to those of *O. lepida*, is also a synonym of *purpurea*. Both Döderlein and Koehler (1898: 102) say that *O. lepida* and *O. lorioli* cannot be confounded, but neither of them give any reason for this.

Macrophiothrix hirsuta (Müller & Troschel)

Ophiothrix hirsuta Müller & Troschel, 1842: 111. Marktanner-Turneretscher, 1887: 311. †Koehler, 1922*a*: 234, pls. xxxi. 1, 2; xxxiii. 13; xcix. 2. Tortonese, 1949: 37.
Ophiothrix cheneyi Lyman, 1861: 84.
Macrophiothrix hirsuta, H. L. Clark, 1938: 285.
Ophiothrix demessa, H. L. Clark, 1939: 83. [non *Ophiothrix demessa* Lyman, 1861: 82.]

Sherm Sheik; 1 specimen. Sanafir; 1 specimen. Dahab; 2 specimens.

Remarks. There seems to be considerable difference of opinion as to the shape of the dorsal arm-plates in this species. H. L. Clark describes them as more or less oval in his key to the species of *Macrophiothrix*, but as Tortonese points out, Müller & Troschel's original description mentions lateral angles, a statement open to several interpretations but suggesting at least something a little more angular than an ellipse. Koehler's plate 83, fig. 13, of the arm of a Philippine specimen shows dorsal arm-plates of which the widest part is midway between proximal and distal edges, whereas all the Red Sea specimens that I have seen have the widest part distinctly distal to the half-way line with a slightly rounded angle as opposed to the very acute angle of *M. longipeda*. This rather fan-shaped form is shown in Koehler's plate 31, fig. 1, of a specimen from the Red Sea, which also resembles the present material in the characters of the disk. That the shape of the dorsal arm-plates varies in different parts of the range is shown by the fact that Lyman's species from Zanzibar, *O. cheneyi*, which is commonly accepted as a synonym of *M. hirsuta*, is described as having oval, microscopically granulated dorsal arm-plates.

The latter feature, that is the presence of more or less thorny granules on the dorsal arm-plates, is not mentioned by Müller & Troschel, but Marktanner-Turneretscher states that they are always somewhat granulated although this is not so marked as in *O. demessa*. In fact he considers the difference in the size and thorniness of these granules to be the only difference separating the two species. Through the courtesy of Dr. Elisabeth Deichmann I have had the opportunity of studying some specimens of *O. demessa* and as a result fully agree with Marktanner-Turneretscher, the only other difference that I can see being that the arms seem to taper more rapidly, in younger specimens at least, of *O. demessa*. The granules on the arms are distinctly more thorny than in the specimens from the Red Sea, where they may be quite unobtrusive in spirit specimens. H. L. Clark in his John Murray Report names two specimens from the Red Sea and the Gulf of Aden *Ophiothrix demessa*, of which the one in the British Museum is indistinguishable from *M. hirsuta*, and I suspect that Koehler's record of *O. demessa* from the Red Sea is also based on a similar specimen. In 1946 H. L. Clark erected a new genus *Amphiophiothrix* to accommodate the species *O. demessa*, but I cannot agree that there is a generic distinction between it and *Macrophiothrix hirsuta*.

The validity of some of the other Indo-Pacific species of *Macrophiothrix* has been questioned by several authorities. Some of them are possibly variants of other species such as *hirsuta* in which the granulation of the radial shields is reduced, for there is a tendency for such a reduction throughout the genus as there is also for the development of granules on the dorsal arm-plates, a character featuring in the descriptions of several species, such as *M. rugosa* H. L. Clark, and noticeable also in some larger specimens of other species. However, without seeing the types and being able to compare them with large series of specimens from different parts of the Indo-Pacific, it is impossible to add anything concrete to the suspicions already voiced.

3. CRINOIDEA

Family Comasteridae

Capillaster multiradiata (Linnaeus)

Asterias multiradiata, Linnaeus, 1758: 663.
Capillaster multiradiata, A. H. Clark, 1909: 364.
†*Capillaster multiradiata*, A. H. Clark, 1931: 173, pls. iii. 5; xi. 30; xiii. 34; xiv. 35, 36; lxxxi. 222, 223, also many text-figs.

Dahab; 1 specimen; arms 90 mm. in length.

This is the first record of this species from the Red Sea, the former known range being from Formosa south to northern Australia and west as far as the Maldive Islands, so its discovery here is most interesting.

There are 36 arms, which is rather more than usual; A. H. Clark gives 12 to 35 as the usual range, but quotes specimens with up to 43 arms.

4. ECHINOIDEA

Family Toxopneustidae

Tripneustes gratilla (Linnaeus)

Echinus gratilla Linnaeus, 1758: 664.
Tripneustes gratilla, Loven, 1887: 77. †Mortensen, 1943, **3** (2): 500, pls. xxxiii. 1–3; xxxiv. 2–6; xxxv. 3–4; xxxvii. 1–2, 4–10; xxxviii. 1–4; lvi. 11.

Abu Zabad, reef at low spring tide; 3 specimens. Sanafir; 1 specimen. Dahab; 6 specimens. Aqaba; 2 specimens.

The two from Aqaba are superficially very different from the others, having relatively few and long primary spines above the ambitus, which are white in colour and contrast sharply with the dark purple of the test, produced mainly by the numerous pedicellariae. The tube feet of these two specimens are black or at least have a black band around them. The other specimens are more drab in colour, several being slightly reddish and their tube feet are grey. The denuded tests are distinctly green aborally.

Family Clypeastridae

Clypeaster (Rhaphidoclypus) fervens Koehler

Clypeaster fervens Koehler, 1922: 45, pls. vi. 1, 2, 6; xv. 1.
†*Clypeaster* (*Rhaphidoclypus*) *fervens*, Mortensen, 1948, **4** (2): 84, pls. xiii. 2, 3; xxii. 1–11; xxvi. 2; lxv. 7–9, 12, 20.

Dahab, shore; 1 dead test.

This specimen is easily distinguished from *Clypeaster humilis* by the relatively large petals and the concave oral side. It is 46 mm. in length but already has well-developed genital pores. According to Dr. Mortensen (who has very kindly confirmed my identification) in his monograph, the genital pores only begin to appear when the length is about 56 mm., that is in the John Murray Expedition material from the Indian Ocean. It seems then that in the Red Sea this species undergoes precocious genital development.

5. HOLOTHUROIDEA

Family Holothuriidae

Holothuria sucosa Erwe

Cucumaria hartmeyeri Helfer, 1912: 332. [non *Holothuria hartmeyeri* Erwe, 1913: 383, pl. vii. 19.]
†*Holothuria sucosa* Erwe, 1919: 186, text-fig. 5. Panning, 1934, **3**: 80, text-fig. 64.
? *Holothuria ocellata*, Tortonese, 1936: 235, text-figs. 5, 6.

Dahab; 1 specimen.

The knobbed buttons have 4 or 5 pairs of holes, sometimes as many as 10 pairs. Unlike *H. arenicola* var. *boutani* Herouard, which also has multilocular, though flat buttons, the tables, which are also larger, have a complete ring of holes around the margin not interrupted by the extended four central holes. Unlike *H. ocellata* Jäger, the great majority of buttons have more than 3 pairs of holes.

Microthele nobilis (Selenka)

Mulleria nobilis Selenka, 1867: 31, pl. xvii. 13–15.
†*Holothuria* (*Microthele*) *nobilis*, Panning, 1929, **1**: 131, text-fig. 15.
Microthele nobilis, Heding, 1940: 320.

Ras Muhammad; 1 specimen.

Although shrunken in preservation this specimen still measures 24 cm. in length. The tables have mostly rather irregular disks. The other dorsal deposits are 'three-dimensional buttons', fenestrated irregularly with about 4 pairs of holes on each face. Ventrally, however, these spicules are much outnumbered by more conventional flat buttons with holes in one plane, there being usually 4 or 5 pairs of holes if not more.

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Legends to Plates 31 and 32

PLATE 31

Fromia ghardaqana Mortensen, specimen from Dahab. (*a*) Dorsal side; (*b*) ventral side; (*c*) specimen 40.3.23.35; and (*d*) *Fromia milleporella* Lamarck, specimen 39.3.29.20, for comparison.

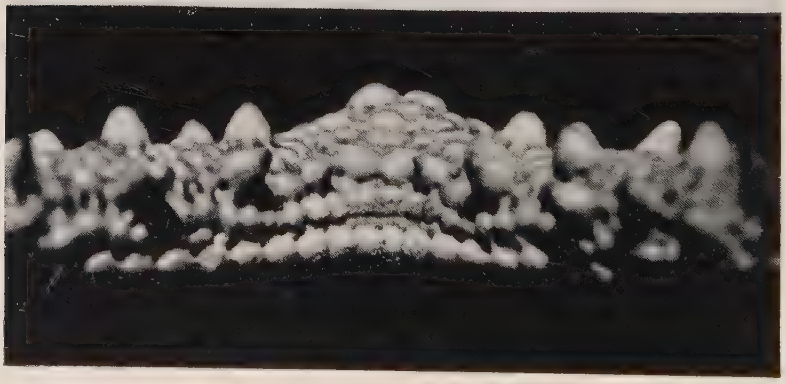
PLATE 32

Gomophia egyptiaca Gray. (*a*) Dorsal side of the type and (*b*) an interbrachial angle to show the intermarginal plates.

FROMIA GHARDAQANA MORTENSEN (Figs. *a-c*)
FROMIA MILLEPORELLA LAMARCK (Fig. *d*)

a

b



GOMOPHIA EGYPTIACA GRAY

VIII. TUNICATA

By WILLARD G. VAN NAME

AMERICAN MUSEUM OF NATURAL HISTORY

THROUGH the kindness of the authorities of the British Museum (Natural History) the Tunicata collected by the M.Y. *Manihine* in the Gulf of Aqaba in the early months of 1949 were forwarded to me for examination.

As far as I am aware no collection of Tunicata has previously been made there, but the tunicates of the Red Sea, and especially those of the Gulf of Suez, have been the subject of much study and are dealt with in several published articles.

The remarkable work by Savigny (1816), which was many decades in advance of his time, and which laid the foundations of much of our knowledge of the Tunicata, as well as important articles by Hartmeyer, Michaelsen, and others during the present century, were based in large part on specimens from those waters.

It was therefore hardly to be expected that new species would be found in a comparatively small collection, especially since no specimens were obtained except in very shallow water, in no case over about 2 fathoms.

All the specimens appear to be referable to species already described, but nevertheless the collection contains some that are of interest, especially those of the solitary form of *Salpa maxima* var. *tuberculata* described by Metcalf, 1918, from the southern Philippines, who, however, had specimens of the aggregated form only.

Since the Gulfs of Suez and Aqaba are extensions of the Red Sea and consequently of the tropical part of the Indian Ocean, their faunas are Indo-Malayan, in spite of their near approach geographically to the eastern Mediterranean.

This fact is, however, not so evident in the present collection as might be expected, since it happens to contain some species that are practically circumtropical, and found both in the Mediterranean and Indian Ocean. These species are shallow water forms, and it is possible that some of them may owe their very extensive distribution to human agency, by transportation on the bottom of ships.

The Tunicata in this collection appear to belong to the following 13 species, one of them (*Salpa maxima*) being perhaps represented by two varieties:

Class ASCIDIACEA

COMPOUND ASCIDIANS

1. ***Polyclinum saturnium*** Savigny, 1816

Polyclinum saturnium Savigny, 1816: 190, pl. 19, fig. 1; Michaelsen, 1920: 9.

One rather thick colony measuring over 50 mm. in extent.

2. ***Didemnum candidum*** Savigny, 1816

Didemnum candidum Savigny, 1816: 194, pl. 4, fig. 3, pl. 20, fig. 1.

Several small colonies with abundant spicules, whose points are so short and

slightly developed that the spicules are almost spherical. Also one small colony having spicules with larger and better developed rays or points.

There is also one colony, growing on coral, which has very few spicules and a great many faecal pellets in the intestinal tracts of the zooids, perhaps indicating an incipient case of the so-called 'Hypurgon' condition to which this and allied forms are subject, in which the water currents in the cloacal canals become too weak to carry off the waste material, which remains in the cloacal system and in the common test, greatly altering the character and appearance of the colony, but there does not seem to be any reason for assuming that it is of a different species. See Michaelsen, 1919*a*: 11–13.

Didemnum candidum appears to be a species of very wide distribution, being found also in American waters, very abundantly in some places.

It cannot be doubted that far too many species of the genus *Didemnum* have been described. Apparently this is in part due to overlooking the great effects on the general appearance of the colony of its age and past history, particularly in the case of old colonies. Many or most of the species are subject to periods (in many cases seasonal) of regression and extensive degeneration of the zooids, followed by subsequent recovery and regrowth of the colony to its normal functional condition. During such regressive periods, though the zooids degenerate more or less completely, the spicules may endure unchanged through several or perhaps many generations of the zooids. The result is that in old colonies we may find a far greater abundance of spicules than the spicule-forming ability of the zooids present could possibly account for, and likewise often peculiarities in the distribution of the spicules, which one must not mistake for specific characters. Old colonies are apt to acquire a hard calcareous character in which the spicules form a far larger component than the test substance and zooids do.

Simple Ascidians

3. ***Phallusia nigra*** Savigny, 1816

Phallusia nigra Savigny, 1816: 163, pl. 2, fig. 2; pl. 9, fig. 1.
Ascidia atra Lesueur, 1823: 2, pl. 1, fig. 2.
Ascidia nigra, Herdman, 1882: 210.
Phallusia nigra, Hartmeyer, 1916: 408, figs. 5–9.

Eleven specimens, all of small size. This species, widely distributed and common in shallow water in many warm regions of both hemispheres, is easily recognizable from its bluish or blue-black coloration.

If *Phallusia* is accepted as a genus distinct from *Ascidia*, the present species should be placed in it, as in old and large individuals the neural duct has accessory apertures, at least in many specimens. In other respects it is a very typical *Ascidia*.

4. ***Phallusia*** sp., apparently ***Phallusia arabica*** Savigny, 1816

Phallusia arabica, Hartmeyer, 1916: 414, figs. 10–12.

One specimen of 52 mm. body length (or 63 mm. if the obliquely forwardly extending atrial siphon is included). In external features other than unusual forward

position of the atrial siphon (probably only an individual peculiarity), as well as in a majority of the internal characters, it agrees well with the descriptions of Savigny and Hartmeyer cited above.

But this specimen is abnormal and defective in the slight development of the dorsal tubercle, which is practically wanting, although its aperture, which is U-shaped, with the open interval obliquely forward and to the left and with one of the ends bent down, is clearly visible, but very small. Yet I was not able to find any neural duct extending from its aperture, nor any neural gland. Even the ganglion was only doubtfully demonstrated. The neural duct should be long in this species, with accessory lateral openings as well as the terminal one in the dorsal tubercle. The tissues of this specimen were dark coloured and somewhat opaque, but that would not account for the difficulty of finding the above structures if they were present in a normal state of development.

5. ***Ascidia cannelata*** (Oken), 1820

Phallusia sulcata Savigny, 1816: 162, pl. 9, fig. 2. (Name preoccupied.)
Phallusia cannelata Oken, *Isis, 1820*: 796.
Ascidia cannelata, Hartmeyer, 1916: 400, fig. 1.

One specimen, 32 mm. in length, growing on coral.

6. ***Rhodosoma turcicum*** (Savigny), 1816

Phallusia turcica Savigny, 1816: 165, pl. 10, fig. 1.

Seven specimens, all rather small except one 45 mm. long. This, apparently the only species of its genus, is found in many tropical seas, and is readily recognizable by the two apertures being near together in a cleft of the test which can be tightly closed to give them protection. Said to be in most places a rather uncommon species; apparently the Gulf of Aqaba is an exception, as is also the island of Curaçao, West Indies.

7. ***Cnemidocarpa hemprichi*** Hartmeyer, 1916

Cnemidocarpa hemprichi Hartmeyer, 1916*a*: 218, figs. 6, 7.

One specimen of very irregular external form, about 29 mm. long. Found associated with coral in a depth of 2 fathoms.

8. ***Polycarpa mytiligera*** (Savigny), 1816

Cynthia mytiligera Savigny, 1816: 158, pl. 8, fig. 2.
Polycarpa mytiligera, Hartmeyer, 1916*a*: 208, figs. 1, 2.

Two specimens, each of which contained a relatively large symbiotic macruran crustacean in the branchial cavity.

9. ***Herdmania momus*** (Savigny), 1816

Cynthia momus Savigny, 1816: 143, pl. 1, fig. 2; pl. 6, fig. 1.
Cynthia pallida Heller, 1878: 96, pl. 3, figs. 17, 18.

Five specimens, all of rather small size and apparently all representing the typical variety of this widely distributed species of warm regions.

10. ***Microcosmus exasperatus*** Heller, 1878

Microcosmus exasperatus Heller, 1878: 99, pl. 3, fig. 19.

Three very small specimens. This is also a species of extensive distribution in tropical and warm-temperate waters.

11. ***Halocynthia spinosa*** Sluiter, 1905

Halocynthia spinosa Sluiter, 1905: 15, pl. 2, figs. 8–8*d*.

Five specimens, the largest about 20 mm. in greatest diameter.

This species, more or less red or pink in colour in life, is easily recognizable from its spiny exterior, the spines about the aperture on the siphons being especially long and conspicuously provided with sharp lateral branches.

12. ***Molgula dione*** (Savigny), 1816

Cynthia dione Savigny, 1816: 153, pl. 7, fig. 1.

One specimen, about 22 mm. long, found on coral.

Class THALIACEA

Pelagic Tunicata

All the Thaliacea in the collection are of one species, *Salpa maxima* Forskål, 1775, which is found in both the Atlantic and Pacific Oceans, and though reported also from the southern part of the Indian Ocean, has apparently not previously been recorded from the Red Sea. The specimens, with the possible exception of some immature ones as noted below, belong to the following variety of this species:

13. ***Salpa maxima*** Forskål, 1775, var. ***tuberculata*** Metcalf, 1918

Metcalf, 1918, *Bull. U.S. Nat. Mus.*, No. 100, **2** (2): 87, fig. 72.

Described by Metcalf (who had examples of the aggregated form only, from the southern Philippines). The 'Manihine' collection has large adult examples of both aggregated and solitary forms, collected with dip nets near the surface, in some cases with the aid of a light.

Five adult specimens of the aggregated form agree well with Metcalf's description and figures, in having the anterior and posterior processes of the body longer than in the typical *S. maxima*, and in having on each side of the external body surface an oval area of the thickened test at the base of the atrial siphon, bearing small acute conical spinous tubercles as described by Metcalf, the area on left side being the larger.

Four adult examples of the hitherto undescribed solitary form of the variety *tuberculata*, the largest about 135 mm. in length, also differ from the solitary form of the typical *S. maxima* in having external spinous areas, though these are small. There are three of these in the case of the solitary form, the most conspicuous one being a narrow transverse strip of thickened test extending across the rear end of the

body just below (ventral to) the base of the atrial siphon, bearing two not very regular rows of conical spinous tubercles similar to those in the aggregated form. The rows are one above the other, and extend slightly farther on the left than on the right side. On the dorsal surface of the body, above the intestinal 'nucleus', there is on each side a thickened area of test bearing a few conical tubercles, but both areas are of small extent, especially the one on the right side.

The variety *tuberculata* appears to be a well-marked one, but the differences from the typical form are superficial and hardly seem to justify considering it a distinct species, especially since we do not yet know the extent to which intermediate forms may occur.

The collection also contains a number (over 50) of young specimens of *S. maxima*, aggregated form, measuring up to about 20 mm. in length exclusive of the anterior and posterior processes. Many of these, when collected, were still adhering together as parts of chains, but due to transportation and handling are now all separated. It is likely that they are all the young of the variety *tuberculata*, but as they fail, probably because too young, to show the varietal characters, they have been labelled simply *Salpa maxima*.

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APPENDIX

Ascidian from Mukalla Bay

Apparently *Ascidia savignyi* Hartmeyer, 1916

A large specimen of the genus *Ascidia* from Mukalla Bay, South Arabia (A. Fraser-Brunner, coll. 17–12–1948) is not included in the above list of specimens as it was not from the Gulf of Aqaba. It is remarkable for its large size (about 160 mm. long by 35 mm. transversely) and greatly elongated form, due chiefly to much lengthening of the anterior half of the body, though the siphons (both of which arise at the anterior end) are short, and the branchial one is much distorted. The internal structure does not show much abnormality, though the branchial sac extends close to the anterior end of the body, and the dorsal tubercle (whose aperture is irregular S-shaped, with the upper end bent down), also the neural gland and ganglion, are close to it and very near to the circle of tentacles. The branchial sac has no intermediate papillae; the internal longitudinal vessels are numerous (over 70 on the left and over 80 on the right side); the intestinal loop (about 37 mm. long) is far back in the body.

It is evidently an unusually old individual; one that has grown in a favourable position in respect to food-supply and protection from predatory fishes and crabs, but where surrounding obstructions compelled it to become unusually elongated.

A similar specimen might be hard to find again, but I do not think it should be assumed to be a new and undescribed species, though such mistakes have too often been made, resulting in burdening literature with supposed species having no real existence. Such a specimen is hard to identify with certainty, but I think it is an unusually large and abnormally shaped example of *Ascidia savignyi* Hartmeyer, 1916. (*Sitzungsber. Gesell. naturf. Freunde Berlin*: **1916:** 404), described from the Sinai coast and Gulf of Suez.

In that article Hartmeyer mentioned (p. 407) the close relationship of *A. savignyi* to *A. depressiuscula* Heller, 1878, described from Ceylon, and common in the Philippines, which is a species that also attains rather large size. I am quite ready to agree with this opinion, and think he was also probably correct in believing it related to the European species *A. virginea* Mueller, but I do not consider it also related to *A. paratropa* (Huntsman) of the American Pacific coast, as Hartmeyer believed. That species has intermediate papillae on the branchial sac, and belongs to a different section of the genus.

IX. FISHES

By N. B. MARSHALL, M.A.

THE collection comprises 113 species, of which 1 is new, while 4 sub-species have been proposed. There are 11 new records for the Red Sea (these being indicated by an asterisk preceding the name of the species).

Collections were made from 28 December 1949 to 16 February 1950, coming from various localities along the Sinai shores of the gulf and from an area around the entrance. These include Aqaba, Faraun Island, Graa, Mualla, Wasit, Hobeik, Dahab, Um Nageila, and Abu Zabad within the gulf and Tiran Island, Sanafir Island, Sherm-el-Moiya, Sherm Sheikh, and Ras Muhammad Bay around the entrance. For the positions of these localities reference should be made to the chart in the introduction to this series of reports.

The fishes were captured by a variety of methods: cast-net, fish-trap, hand-lines, trolling gear, and dip-net. In addition many were taken by bringing up pieces of coral and breaking them open to obtain the enclosed fishes, while a number were obtained from pools along the reef at low water. The method of capture is indicated under each species, giving certain information on the habits of the fish. For example, those taken by cast-net occurred singly or in shoals in shallow water close to the shore, while those taken by trolling spoon or live bait were nearly always caught along the seaward edge of reefs, where they appear to station themselves to prey on smaller fishes living in association with coral. Clearly those found within pieces of coral must live in close association with it, darting back to shelter on being disturbed by the diver. Perhaps no more striking way of appreciating the direct or indirect dependence of so many tropical fishes on coral can be obtained than through the many ways necessary to obtain them as specimens.

SELACHII

CARCHARINIDAE

Negaprion acutidens (Rüppell)

1 specimen of length 660 mm.[1] taken close inshore in Ras Muhammad Bay.

Carcharinus melanopterus (Quoy & Gaimard)

1 specimen of 535 mm. caught by hand-line at Sanafir Island.

Carcharinus albimarginatus (Rüppell)

1 specimen of 870 mm. caught by hand-line at Sherm Sheikh.

[1] Except for the Selachii and the eels, lengths throughout this paper refer to the standard length.

RHINOBATIDAE

Rhinobatus halavi (Forskål)

Six specimens were taken in very shallow water in Ras Muhammad Bay. One of these is a female of length 507 mm., while the rest are males ranging from 355 to 520 mm.

DASYATIDAE

Dasyatis uarnak (Forskål)

One specimen taken by hand-line at a depth of 10 fathoms at the anchorage in Sanafir Island. The disk is about 1,000 mm. in length and 1,250 mm. wide. The tail, from which the whip-like end is missing, has a length of about 1,250 mm.

Taeniura lymma (Forskål)

Three specimens were obtained by cast-net close inshore at Sanafir Island (length 570 mm.), and at Mualla (length 445 mm.) and Um Nageila (length 564 mm.) within the Gulf of Aqaba.

ISOSPONDYLI

CLUPEIDAE

Sub-family DUSSUMIERIINAE

Spratelloides delicatulus (Bennett)

Individuals of this species were taken with a dip-net and Aldis lamp at night. Faraun Island: 10 specimens from 21 to 50 mm. Sanafir Island: 15 specimens from 40 to 45 mm.

Spratelloides gracilis (Schlegel)

Like the preceding species, this was caught by dip-net at night in the light of an Aldis lamp. Hundreds of specimens were taken at the anchorage at Sanafir Island, ranging in length from 9 to 39 mm.

I have compared some of these specimens with material in the museum collections from Japan and Formosa (the type locality being along the south-east coast of Nagasaki). There are differences in the number of pectoral and anal fins as shown in the table below:

	Pectoral (left)			*Anal*			
No. of rays	13	14	15	11	12	13	14
Red Sea specimens	3	7		5	7	1	
Japanese specimens		3	6		2	6	2

On the basis of the above counts it seems not unlikely that the Red Sea populations should be separated as a distinct sub-species; but lacking data from areas between the end points of the range of this species it is considered premature to subdivide it.

INIOMI

Synodontidae

Synodus variegatus (Lacépède)

One specimen of 130 mm. taken in a pool at Dahab.

APODES

Muraenidae

Echidna nebulosa (Ahl)

Two specimens of 444 and 460 mm. taken on the reef at Abu Zabad at low tide.

Echidna polyzona (Richardson)

One specimen from Abu Zabad of 195 mm. and two from Sanafir Island of 115 and 165 mm. The latter were found in a piece of madreporarian coral.

Gymnothorax meleagris (Shaw)

Seven specimens were obtained from the following localities: Dahab (108 mm.), Abu Zabad (145 and 160 mm.), Sanafir Island (111, 165, and 180 mm.), Sherm Sheikh (100 mm.). Except those from Abu Zabad, which were obtained on the reef at low tide, all were found in pieces of madreporarian coral brought up for examination.

Gymnothorax flavimarginata (Rüppell)

One specimen of 295 mm. taken on the reef at Abu Zabad at low tide and one of 880 mm. from Ras Muhammad Bay.

Gymnothorax geometrica (Rüppell)

Two examples of 130 and 143 mm. taken from pieces of coral at Sherm-el-Moiya and Sanafir Island respectively.

The body colour of these specimens was fawn with the pattern of dark pigment

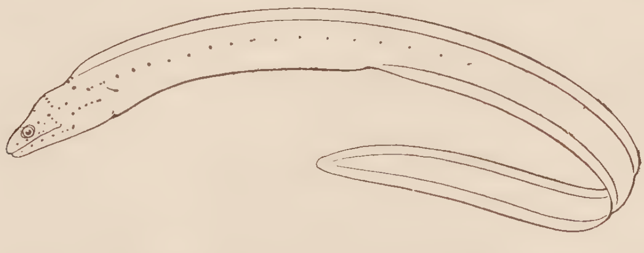

Fig. 1. An immature specimen of *Gymnothorax geometrica* (Rüppell) from Sherm-el-Moiya in the northern Red Sea, showing the pattern of dark spots on the head and body.

spots on the head looking rather like a series of lateral line pores (see Fig. 1). These spots extend down the mid flanks as a single line, extending just beyond the anus.

This spot pattern was also found in specimens from the collections labelled *Gymnothorax thyrsoidea* (Richardson): 2 from Rodriguez, 1 from the Seychelles, 1 from Muscat. These specimens differed from those listed above in having a dotted and speckled body coloration, but as all these Indian Ocean examples were much larger it is likely to be a difference due to age. Rüppell's (1828) figure shows a mottled body coloration.

There can be no doubt that *G. geometrica* (Rüppell) and *G. thyrsoidea* (Richardson) are very closely related, the only apparent difference between them being the absence of the spot pattern in the latter. However, as this pattern seems quite constant in *G. geometrica* and as the pattern only appears to be found in individuals from the western Indian Ocean, the two species have been kept separate. Further work may perhaps show that what is now called *geometrica* is a western Indian race of a widely spread species. (This species will, of course, need to be called *G. geometrica*—this name having priority over *G. thyrsoidea*.)

If *Gymnothorax geometrica* is a distinct species its distribution must include the western Indian Ocean as well as the Red Sea.

Uropterygius polyspilus (Regan)

One specimen from Sanafir Island of length 201 mm. taken in a piece of coral.

Schultz (1943) has suggested that this species is perhaps the young of *Uropterygius tigrinus* (Lesson). Examination of the above specimen, together with the type specimen from Tahiti (length 183 mm.) and two specimens from Samoa (331 mm.) and Zanzibar (715 mm.), shows that *polyspilus* is distinct from *tigrinus* (a specimen of 860 mm. was examined) in the following characters:

1. The number and size of the outer maxillary teeth: 20–28 in *polyspilus*, which are much smaller than the inner series of maxillary teeth; 12–13 in *tigrinus*, which are nearly the size of the inner series. (Bleeker, *Atlas Ichthyologique*, **4**, 1864: 113, counts 16 outer maxillary teeth for *tigrinus*. The figure on plate 165 shows them almost equal in size to the inner series.)
2. The proportions between trunk and tail: about equal in length in *polyspilus*, but in *tigrinus* the trunk is about 1·7–1·8 times longer than the tail.
3. The proportions between the eye and the snout: in *polyspilus* the length of the snout is from 1·7 to 1·8 times the diameter of the eye, whereas in *tigrinus* the snout is about 2–3 times the eye diameter.

SYNENTOGNATHI

Belonidae

Strongylura crocodilus (Lesueur)

One specimen from Sanafir Island of 465 mm.

Hemirhamphidae

Hemirhamphus far (Forskål)

One specimen from Sanafir Island of 300 mm.

EXOCOETIDAE

Danichthys rondeletii (Cuvier & Valenciennes)

Four specimens taken off Alexandria, which were attracted on board by a light. Lengths 152, 164, 173, and 180 mm. Bruun (1935) has suggested that *D. rondeletii* in the Mediterranean might prove to be a dwarf race distinct from the Atlantic form. Examination of the above specimens, 2 others from the Mediterranean (B.M. Reg. No. 73.4.21.2–3) and 1 from the Atlantic (B.M. Reg. No. 71.12.28.8) has yielded data which when added to those listed by Bruun and Breder (1938) provides evidence to support this suggestion.

The essential differences between the two forms are in the number of pectoral rays and transverse scales (and very probably in the sizes attained, the Atlantic form being known up to 234 mm. in standard length and the Mediterranean up to 187·5 mm.). These differences are shown below:

Atlantic specimens	*Pectoral rays*	*Mediterranean specimens*
1	16	3
11	17	9
5	18	1
1	19	

Atlantic specimens	*Transverse scales (between origin of dorsal fin and lateral line)*	*Mediterranean specimens*
2	6½	9
13	7½	1

It would appear from these data that the Mediterranean form can nearly always be separated from the Atlantic by the number of transverse scales. If more evidence, in particular more from the Mediterranean, shows this is so, then this species must be split into Atlantic and Mediterranean sub-species.

MICROCYPRINI

CYPRINODONTIDAE

Aphanius dispar (Rüppell)

One female of 32 mm. taken on the reef at Abu Zabad at low tide.

SOLENICHTHYES

FISTULARIIDAE

Fistularia villosa Klunzinger

Four specimens from Dahab from 600 to 790 mm. Another specimen of 105 mm. taken with a dip-net at Sanafir Island is probably of this species. In determining this species I have used the revision by Duncker & Mohr (1925) and other specimens in the collections.

The colour was noted as follows: 'a line of misty-blue spots on either side of the mid-dorsal line extending from the pectoral fins to the dorsal. Below this line (about ½″) a continuous misty-blue line extended from about 1″ in front of the pelvics to 1″ behind the end of the dorsal, thereafter continuing as a line of spots.'

Syngnathidae

Micrognathus brevirostris (Rüppell)

Three specimens found in a piece of coral at Sanafir Island. Two males of 37·0 and 47·5 mm. and one female of 44·0 mm.

BERYCOMORPHI

Holocentridae

Holocentrum spiniferum (Forskål)

Three specimens taken by hand-line at Sanafir Island (278 and 300 mm.) and Sherm Sheikh (295 mm.) at depths of about 10 fathoms.

Holocentrum sammara (Forskål)

One specimen from Sanafir Island (length 134 mm.).

Holocentrum diadema Lacépède

Two specimens of about 45 mm. from a piece of coral at Tiran Island.

Holocentrum lacteoguttatum (Cuvier & Valenciennes)

Two specimens of 45 and 54 mm. Taken at low tide on the reef at Abu Zabad.

PERCOMORPHI

(Sub-order PERCOIDEA)

Serranidae

(Sub-family serraninae)

Plectropoma maculatum (Bloch)

One specimen of 440 mm. caught by hand-line at Sanafir Island.

Variola louti (Forskål)

Two specimens of 385 and 287 mm. taken by hand-line at Dahab (10 fms.). This species could also be caught by trolling a spoon or live bait.

Cephalopholis miniatus (Forskål)

Two specimens of 280 and 287 mm. taken by hand-line at Dahab.

Cephalopholis hemistictus (Rüppell)

Three specimens, two from Dahab of 131 and 140 mm. and one from Hobeik of 131 mm.

Intensive field and laboratory work may show the two above species to be synonymous. Klunzinger (1884) states that the only distinguishing feature is in the coloration, which he says is constant in *hemistictus*. There is, however, considerable variability. The usual body colour in *hemistictus* is brownish or dark olive-green with small bright blue, ocellated spots on the head and lower half of the flanks (mainly found on the thoracic and abdominal regions), while there is a broad yellow edging to the pectoral fin. The three specimens from the Gulf of Aqaba differ from this in the general body colour, this being a bright red as in *C. miniatus*. (Two other specimens from the Gulf of Aden and one from the Makran coast also must have had this coloration.) What is also interesting on all these specimens are the pale pelvic fins with a narrow outer black edging which is also found in *C. miniatus* (in typical *C. hemistictus* they have a general, dusky pigmentation). Again, the area of the body covered with the blue spots in *hemistictus* varies considerably from being confined to part of the abdominal region to practically extending over the lower half of the flanks, with a few spots appearing dorsally above the lateral line. Finally in five specimens labelled *Epinephelus miniatus* from Mombasa there are two specimens of 226 and 242 mm. with the normal colour pattern, while the remaining three from 151 to 171 mm. (which agree in all characters but colour with the above two) are completely plain coloured. There is no trace of spots and only a faint dark edging to the caudal and anal fins can be seen. Presumably these were coloured a bright red in life.

Although it is quite possible that these species merge with one another, they have been separated particularly on account of the difference in distribution, *Cephalopholis hemistictus* being confined to the Red Sea and western Indian Ocean, whereas *C. miniatus* occurs throughout the Indo-West-Pacific area. There is here an interesting parallel with the eels *Gymnothorax geometrica* and *G. thyrsoidea* which were discussed earlier in this report.

Epinephelus summana (Forskål)

One specimen of 440 mm. from Sanafir Island taken by hand-line.

Epinephelus fuscoguttatus (Forskål)

Six specimens. Four from Sanafir Island from 325 to 890 mm. caught by hand-line in depths from 5 to 20 fathoms. Two from Abu Zabad of 51 and 123 mm. taken on the reef at low tide.

Epinephelus fasciatus (Forskål)

Seventeen specimens taken at the following localities: Dahab, 5 from 34 to 175 mm.;

Hobeik, 3 from 190 to 220 mm.; Abu Zabad, 7 from 46 to 76 mm. collected from pools on the reef at low tide; Sanafir Island, 1 of 43 mm.; Sherm Sheikh, 1 of 205 mm.

(Sub-family THERAPONINAE)

Therapon jarbua (Forskål)

Thirteen specimens captured by cast-net at Sherm Sheikh (12 from 79 to 116 mm.) and at Abu Zabad (1 of 167 mm.).

Investigations of these specimens together with others in the collections has shown that there are certain regional differences in the number of dorsal spines and the relation between the depth of body and the standard length as shown in the following table:

Area	*No. of dorsal spines* 11	12	$\frac{\textit{depth}}{\textit{length}} \times 100$	*No. of specimens*	*Size range (mm.)*
Red Sea	13	—	29·5–32·0	13	79–167
Arabian coast . . .	5	—	32·0–35·0	5	80–276
Persian Gulf . . .	4	2	33·0–38·0	6	58–63·5
Coasts of India and Ceylon	12	—	32·1–38·6	12	26–113
East African area . .	2	6	30·7–35·0	8	54–204
East Indies . . .	1	10	32·2–37·0	11	23–151
Philippine Islands . .	1	2	36·1–37·2	3	90–117
Fiji and Samoa . .	—	2	35·5–35·7	2	141–154
China	—	3	31·5–32·9	3	34·5–96·5
Australia . . .	—	2	30·9–33·6	2	67–210

Although these data are rather limited, it is clear that in the Red Sea *Therapon jarbua* has 11 spines in the dorsal fin (previously found by Klunzinger, 1884) and also tends to be slenderer in form than representatives from the Indo-Pacific areas. Furthermore, the proportion of the Indian Ocean specimens having 11 as against 12 spines is 23:8, whereas in the Pacific Ocean this is 2:19. Of specimens from the Pacific, those from the Philippines, Fiji, and Samoa have the deepest body form.

It is thus quite evident that the populations of *Therapon jarbua* are by no means uniform in character. Whether, for example, the Red Sea population can be considered to be part of a sub-species found mainly in the north-west Indian Ocean (having 11 dorsal spines), which intergrades over a wide area with a typical Pacific sub-species (having 12 dorsal spines), can hardly be decided on the present data. It is, however, a problem worth much further investigation.

During this work it became necessary to decide whether *Therapon servus* (Bloch) is distinct from *T. jarbua* (Forskål). Weber & de Beaufort (1931) have synonymized them but refer to the work of Jordan & Thompson (1912), who decided that they were good species, particularly separated by the longitudinal scale counts just above the lateral line. The present work confirms Jordan & Thompson's conclusions and shows that in general *Therapon servus* has relatively smaller scales than *T. jarbua*, as shown in the following table.

Scale count	*Therapon jarbua*	*No. specimens seen*	*Therapon servus*	*No. specimens seen*
1. Longitudinal series above the lateral line	77–89	57	92–105	12
2. Transverse scales	(12) 14–17 / 25–30	55	17–21 / 30–35	12
3. Rows of scales on preoperculum	8–11	57	11–13	12

Serranidae

Sub-family GRAMMISTINAE

Grammistes sexlineatus (Thunberg)

Three specimens from 70 to 82 mm. taken at low tide on the reef at Abu Zabad.

Sub-family PSEUDOCHROMIDINAE

Pseudochromis olivaceus Rüppell

All the examples of this species were taken from pieces of coral brought up by a diver. Within the Gulf of Aqaba collections were made at Graa (2 specimens of 26 and 45 mm.), Mualla (4 specimens of 23–47 mm.), and at Dahab (4 specimens from 37 to 59 mm.). There are also 34 from 26 to 70 mm. taken at Sanafir Island and 8 from 29 to 54 mm. taken at Sherm-el-Moiya.

Comparison has been made between the Gulf of Aqaba individuals and some of those taken outside the entrance in the Red Sea. There does appear to be some difference in the number of pectoral rays, which are tabulated below:

Pectoral rays	*17*	*18*	*19*
Gulf of Aqaba	3	6	1
Sanafir Island	—	10	2

This species is confined to the Red Sea.

Plesiopidae

Plesiops nigricans (Rüppell)

Twenty-three specimens from 33 to 63·5 mm. collected at Abu Zabad at low tide.

Cheilodipteridae

Apogon endekataenia Bleeker

Nine specimens from Abu Zabad from 53 to 61 mm., collected on the reef at low tide.

These specimens agree in structure with two specimens in the collections (labelled as types) which were obtained from Bleeker (B.M. Reg. No. 1880.4.21.59–60). The latter have nearly lost all trace of colour but still retain the remains of the spot on

the base of the caudal fin which Weber & de Beaufort (1929) list as one of the characters separating *A. endekataenia* from *A. novemfasciatus* C.V. Comparison of these specimens with those of *novemfasciatus* shows the two to be very distinct in tooth character. In the latter the teeth are relatively large, there being 4 rows in the upper and lower jaws while in *endekataenia* there are from 6 to 9 somewhat irregular rows of smaller teeth. Comparison of specimens of equal size shows that the teeth of *novemfasciatus* are about twice the size of those of *endekataenia*.

Examination of the museum collections has not revealed any examples of *A. novemfasciatus* from the Red Sea or Indian Ocean. Klunzinger (1884) notes that his specimens (which he names *A. fasciatus* White) show clearly the black spot on the base of the tail. Smith (1949), however, records it as quite common north of Zululand.

Cheilodipterus quinquelineatus Cuvier & Valenciennes

Three specimens from 31 to 38 mm. taken at Abu Zabad.

Latilidae

****Malacanthus hoedtii*** Bleeker

One specimen from Sherm Sheikh of 207 mm.

Carangidae

Caranx fulvoguttatus (Forskål)

One specimen from Sanafir Island of 170 mm.

Caranx sexfasciatus Quoy & Gaimard

Two specimens of 544 and 800 mm. caught by trolling a spinner at Sanafir Island.

Lutianidae

Lutianus bohar (Forskål)

Two specimens caught by hand-line at Sanafir Island (length 310 mm.; depth 20 fms.) and at Sherm Sheikh (length 357 mm.; depth 6 fms.).

Lutianus argentimaculatus (Forskål)

One specimen of 345 mm. caught by hand-line at a depth of 20 fms. at Sanafir Island.

Lutianus fulviflamma (Forskål)

Three specimens caught by hand-line (two from Sanafir Island of 222 and 232 mm. taken at 20 and 8 fms. respectively; one from Sherm Sheikh of 209 mm. from 6 fms.)

Lutianus kasmira (Forskål)

Six specimens taken on hand-lines Four from Sherm Sheikh at 147–182 mm. and two from Hobeik at 209 and 211 mm.

Aphareus rutilans Cuvier & Valenciennes

One specimen of 765 mm. obtained from the cold store at Aqaba.

This is one of the finest food fishes taken in the Gulf of Aqaba and is known to the Arab fishermen as Faris. It is caught by hand-line mainly at depths of about 100 metres.

Mullidae

Parupeneus macronema (Lacépède)

Five specimens. Three obtained by cast-net (two at Dahab of 145 and 149 mm. and one at Sanafir Island of 96 mm.). The other two of 83 and 84 mm. were caught in a fish-trap at Aqaba at a depth of 10 fathoms.

Lethrinidae

Lethrinus nebulosus (Forskål)

Two specimens of 320 and 450 mm. caught by hand-line at Sanafir Island (5 fms.) and Dahab (15 fms.) respectively.

Lethrinus mahsena (Forskål)

Four specimens taken at Dahab (two of 290 and 310 mm. at 12 fms.) and Sanafir Island (two of 225 and 257 mm. at 5 fms.).

Lethrinus microdon Cuvier & Valenciennes

Five specimens, of which three are from Aqaba (86–97 mm.) taken in a fish-trap at a depth of 10 fathoms. The other two were caught by hand-line at Dahab (length 317 mm.; depth of water 7 fms.) and Sanafir Island (length 360 mm.; depth 5 fms.).

Lethrinus mahsenoides ([Ehrenberg] Cuvier & Valenciennes)

Twelve specimens. Seven from Aqaba taken in a fish-trap set at 10 fathoms. Three from Dahab of 176, 183, and 184 mm. caught by hand-line at a depth of 10 fathoms. One from Hobeik of 200 mm. from a depth of 10 fathoms, and one from Sherm Sheikh of 162 mm. from 6 fathoms.

Weber & de Beaufort (1936) have remarked that *L. mahsenoides* from the Red Sea is hardly separable from *L. ornatus* C.V. (= *L. insulindicus* Bleeker). I have compared the above specimens and one of Klunzinger's from the Red Sea (labelled *mahsenoides*) with those labelled '*mahsenoides*' and *insulindicus* taken outside the Red Sea. I could find no significant differences.

Gymnocranius griseus (Schlegel)

One specimen from Hobeik of 300 mm. taken by hand-line at a depth of 10 fathoms.

The above specimen has been compared with two from Mauritius (B.M. Reg. Nos. 1932.8.8.22 and 1934.2.22.25) and one from the Loyalty Islands (77.7.24.2), but there appear to be no differences. Specimens from nearer the type locality (SW. coasts of

Japan) differ from the Red Sea and Indian Ocean examples in being deeper bodied (these were from Hong Kong, B.M. Reg. No. 1939.1.17.38 and the Inland Sea of Japan, B.M. Reg. No. 1907.12.23.230–1). The depth in these is about half the standard length as against $\frac{5}{11}$ to $\frac{5}{13}$ in the Red Sea and Mauritius specimens. There is, also, a difference in coloration, for the Red Sea and Indian Ocean specimens have the wavy blue lines across the head, a coloration which never seems to be present in Pacific Ocean fishes of this species. Fowler (1933) has even made this difference the basis for two sub-genera.

Sparidae

Sparus bifasciatus (Forskål)

Two specimens from Sanafir Island (92·5 mm.) and from Um Nageila (154·0 mm.).

On comparing these specimens with others in the museum collections it became quite evident that there are two definite colour varieties. The first, which is found in the Red Sea, the Gulf of Aden, along the South Arabian coast (Muscat), and in the Persian Gulf, has plain hyaline or yellow dorsal and caudal fins. The other from the Makran coast of Baluchistan, the north-western Indian coast, and the East African area (specimens from Kosi Bay, Zululand, and Rodriguez) always has a black edging to the dorsal fin and sometimes a black edging in the fork of the caudal. Reference to the literature on this species confirms this difference in pigmentation and the geographical range of each type.

In body proportions and height and lengths of the fins there are no significant differences between these two forms. In fin ray and scale counts there are also no differences, except that there appears to be a definite tendency for the East African examples to have 13 rays in the soft dorsal rather than 12. Smith (1938) also gives 13 as the number of dorsal rays in a specimen from Natal. Counting the latter, five out of six East African examples have 13 rays, whereas from the rest of the area of distribution only one out of eighteen had this number; the rest had 12.

It is not the intention to do more at this stage than draw attention to this differentiation within the populations of this bream. More data on the Baluchistan and north-west India populations would be of interest, for at present it appears that, although they have the same colour pattern as the East African, they tend to have 12 dorsal rays rather than 13 (5 out of 6 examined). Yet one specimen from this area did have 13 rays. It is of interest to note that in all instances this number was associated with a black-edged dorsal fin.

Sparus haffara Forskål

Two specimens of 165 and 172 mm. taken by cast-net at Sanafir Island.

Argyrops spinifer (Forskål)

One specimen of 357 mm. caught by hand-line at Dahab at a depth of 10 fathoms.

Diplodus noct ([Ehrenberg] Cuvier & Valenciennes)

Ten specimens taken by cast-net at the following localities: Dahab (2 of 66·0 and 136 mm.), Abu Zabad (2 of 140 and 146 mm.), Sanafir Island (6 from 76·0 to 88·0 mm.).

The distribution of this species is given as the Red Sea, the Arabian and Indian coasts, and Madagascar (Fowler, 1933).

Close comparison of the above material with specimens labelled *Diplodus noct* from Karachi (1) and from the Persian Gulf (11) (from Bushire) has shown them to be quite different. The latter are actually *Diplodus sargus* (Linnaeus). They are, in fact, the same fish as another series labelled *Diplodus capensis* from Muscat, Arabia, the latter being a synonym of *D. sargus*.

The characters showing the differences between *Diplodus noct* from the Red Sea and *D. sargus* from the Persian Gulf and north-west Indian coast are listed below. The measurements and counts on *D. noct* were made on the 10 specimens listed above and 1 other of length 212 mm. from Klunzinger's collection, while those on *D. sargus* were obtained from the 11 specimens from the Persian Gulf (ranging in length from 62·0 to 130·0 mm.), 1 from Karachi (of 109 mm.), and 4 from Muscat (from 140 to 213 mm.).

Diplodus noct (Ehrenberg) (C.V.). The greatest depth of the body is from 39·0 to 42·1 per cent. of the standard length. Dorsal XII. 12–14 (5 specimens with 13 rays, 4 with 14, 1 with 12). Anal III. 12–13 (5 with 12 rays, 6 with 13). Scale count above and below lateral line 6–7/15–16. Number of gill rakers on 1st arch 6–7+1+12–13.

Diplodus sargus (L.). The greatest depth of the body is from 45 to 50 per cent. of the standard length. Dorsal XII. 13–15 (2 specimens with 13 rays, 10 with 14, and 2 with 15). Anal 12–14 (2 specimens with 12 rays, 9 with 13, and 4 with 14). Scale count above and below the lateral line 8–9/15–18. Number of gill rakers on 1st arch 6+1+9–10.

Reference to the literature suggests, in conjunction with the above data, that *D. noct* is confined to the Red Sea. Day (1875) records this species from the Red Sea and Sind (NW. India). His synopsis (p. 133) fits very well with the characters listed above for *D. noct* and his figure (pl. 32, fig. 5) is almost certainly drawn from a specimen of *noct*. Unfortunately he does not state the locality of this specimen, but does mention that this fish is common at Suez. His specimens from NW. India may well have been *D. sargus*.

Sargus kotschyi Steindachner from the Arabian Gulf, Madagascar, which is synonymized with *Diplodus noct* by Fowler (1933), is probably a synonym of *D. sargus*. In particular the number of scale rows (8) above the lateral line is a good indication.

In the course of this work specimens of *Diplodus sargus* from the Mediterranean were compared with those from Muscat and the Persian Gulf and good agreement found between them. The only difference found was in the number of scale rows above the lateral line, which in the Mediterranean examples was 7 to 8 compared to 8 to 9 in those from the Arabian area. It is hoped at a later date to investigate the degree of differentiation within this species.

Crenidens crenidens (Forskål)

Twelve specimens taken by cast-net at the following localities: Dahab (8 specimens from 68·5 to 95 mm.), Sanafir Island (4 specimens from 107 to 120 mm.).

Comparison of these specimens with others from Aden (6 collected by Mr. A. Fraser-Brunner) and Karachi (13) has shown that this species can be divided into two sub-species.

The first is typified by specimens from the Red Sea. The diagnosis which follows is based on the 12 specimens listed above, 1 of 123 mm. from the Red Sea (Rüppell's collection), Ismailia (Suez Canal) (1 of 152 mm.), Korbrat, Suez (1 of 109 mm.), and the Gulf of Suez (1 of 95 mm.). The latter three specimens were collected by the Cambridge Expedition to the Suez Canal, 1924.

Crenidens crenidens crenidens (Forskål)

Depth of body 33·3–38·9 per cent., depth of caudal peduncle 9·9–10·9 per cent., height of third dorsal ray 9·6–11·1 per cent., and length of pelvic fin 18·1–21·2 per cent. of the standard length. Rows of scales above lateral line (from origin of dorsal) 5–6 (7 specimens with 5 rows and 9 with 6 rows). Rows of scales below lateral line 11–12 (2 specimens with 11 rows and 14 with 12 rows). Red Sea.

Synonymy. Presumably all references to *Crenidens crenidens* (Forskål) or *Crenidens forskålii* C.V. from Red Sea localities must come under this sub-species.

Sparus crenidens Forskål, 1775, *Descript. Animal.*: 15 (type locality Red Sea: Djidda or Suez).
Crenidens crenidens, Norman, 1927, *Trans. zool. Soc. Lond.* **22**: 380.
Crenidens forskålii, Cuvier & Valenciennes, 1830, *Hist. Nat. Poiss.* **6**: 378, pl. 162 quater (type locality: Red Sea). Gunther, 1859, (partim) *Cat. Fish. Brit. Mus.* **1**: 424. Klunzinger, 1870, *Verh. zool. bot. Ges. Wien*, **20**: 748. Day, 1875, (partim) *Fishes of India*, **1**: 133.
Crenidens forskaelii, Day 1889 (partim) *Fauna British India* **2**: 35.

The second sub-species is typified by a series of 13 specimens from Karachi ranging in length from 52·5 to 164 mm. The following diagnosis is based on these individuals.

Crenidens crenidens indicus Day

Depth of body 43·3–49·1 per cent., depth of caudal peduncle 11·4–12·8 per cent., height of third dorsal ray 11·6–13·9 per cent., and length of pelvic fin 20·7–25·2 per cent. of standard length. Rows of scales above the lateral line 6–7 (3 specimens with 6 rows and 10 with 7 rows). Rows of scales below the lateral line 12–15 (3 specimens with 12 rows, 2 with 13 rows, 7 with 14 rows, and 1 with 15 rows). Karachi.

Synonymy.

Crenidens indicus, Day, 1873. The sea-fishes of India and Burma from Report on the sea fish and fisheries, p. clxxxvi, No. 184. Day, 1875, *Fishes of India*, pt. 1: 132, pl. 32, fig. 4. Day, 1889, *Fauna of British India*, **2**: 34, fig. 13. Steindachner, 1907, *Denkschr. Akad. Wiss. Wien.* **71** (1): 136. Blegvad, 1944, *Danish Sci. Inv. Iran*, **3**: 143, fig. 80, pl. viii, fig. 3.
Crenidens macracanthus, Gunther, 1874. *Ann. Mag. nat. Hist.* (4) **14**: 368 (type locality: Madras).

Of particular interest are the six specimens from Aden mentioned above which range from 127 to 167 mm. in length. These have the following proportions and

counts: Depth of body, 39·7–44·0 per cent., depth of caudal peduncle 11·1–12·0 per cent., height of third dorsal ray 9·0–11·0 per cent., and length of pelvic fin 20·3–21·5 per cent. of the standard length. Scale rows 6–12 (13 in one specimen).

It will be seen that these individuals resemble *Crenidens crenidens crenidens* in the relative height of the third dorsal ray and the scale counts, but in depth of body, caudal peduncle, and length of pelvic fin they are more like *C. c. indicus*. It was the examination of these intermediate specimens which partly suggested the differentiation of *C. crenidens* into Red Sea and Arabian Sea sub-species.

As the diagnosis shows, the latter sub-species *indicus* is quite distinct along the north-west coast of India and seemingly in the Iranian Gulf, to judge from pl. viii, fig. 3, in Blegvad's report (1944, loc. cit.). More specimens from the south Arabian coasts are clearly required.

There is also little comprehensive data from the East African area. Two specimens from Mombasa and Port Natal of 118 and 186 mm. respectively closely correspond with *C. c. indicus* in body proportions, but like *C. c. crenidens* have 6 and 12 rows of scales above and below the lateral line. On the other hand, the accurate figures of Smith (1938, fig. 21, and 1949, pl. 44, fig. 732), together with the descriptions, give much more the impression of *C. c. crenidens*. It is thus evident that many more specimens from this area must be studied before the *C. crenidens* complex can be more fully appreciated.

Pempheridae

Pempheris sp. (probably *P. moluca* C.V.)

Twenty-five juvenile specimens from 17 to 23 mm. caught by dip-net close inshore at Faraun Island.

Chaetodontidae

Chaetodon fasciatus Forskål

One specimen of 88 mm. caught by cast-net around coral at Sanafir Island.

This species is confined to the Red Sea.

Anisochaetodon auriga (Forskål)

Three specimens of 43, 48, and 51 mm. taken by cast-net at Sanafir Island.

None of these examples have the elongated fifth or sixth dorsal ray. The two smaller specimens have a round black spot towards the 'apex' of the dorsal fin.

Platax orbicularis (Forskål)

Nine specimens from 64 to 84 mm. taken by cast-net at Sanafir Island.

The above individuals together with two more from the Red Sea have been compared with examples from the Indian and Pacific Oceans (Ceylon (2), Seychelles (1), Mombasa (1), Singapore (1), Borneo (2), Philippines (2), Manado (3), and the coast of Savaii (1)).

There appear to be no differences except in the number of pectoral rays (counted in the left fin).

Pectoral rays	*16*	*17*	*18*	*19*
Red Sea . .	3	7	1	—
Indo-Pacific . .	1	4	7	1

Pomacentridae

Amphiprion bicinctus Rüppell

One specimen of 52 mm. taken by dip-net among coral at Dahab.

Abudefduf biocellatus (Quoy & Gaimard)

Eighteen specimens from 34 to 62 mm. taken on the reef at Abu Zabad at low tide.

Three of the above have the typical *biocellatus* colour pattern: the rest have only the posterior ocellus at the base of the last few dorsal spines.

Abudefduf sordidus (Forskål)

Three specimens of 87, 119, and 123 mm. caught by cast-net around rocks.

Chromis coeruleus (Cuvier & Valenciennes)

Forty-eight specimens, all taken from pieces of coral obtained by a diver at the following localities: Sanafir Island, 36 from 22 to 44 mm.; Sherm Sheikh, 9 from 27 to 34 mm.; Dahab, 3 from 18 to 36 mm.

Dascyllus aruanus (Linnaeus)

Forty-four specimens obtained from pieces of coral at the following localities: Sanafir Island, 38 from 17 to 50 mm.; Graa, 3 from 28 to 32 mm.; Dahab, 3 from 40 to 46 mm.

Dascyllus marginatus (Rüppell)

Five specimens from 20·5 to 36·0 mm. obtained from a piece of coral at Dahab (depth 25 fms.).

Comparison of these specimens and others from the Red Sea with those from localities in the Indian and Pacific Oceans has shown that a separate sub-species may occur in the Red Sea. A description of the diagnostic features follows below, based on the five specimens listed above, 1 from the northern Red Sea, taken off the Gulf of Aqaba (length 38·0 mm.), B.M. Reg. No. 1938.1.24.3; 2 from the Red Sea (of 39 and 42 mm.), B.M. Reg. No. 1935.9.1.5; 3 from the Kamaran Islands (from 32 to 41 mm.), B.M. Reg. No. 1937.4.26.8.10; and 18 from Massaua (from 24 to 44 mm.), B.M. Reg. No. 71.4.13.40.

Dascyllus marginatus marginatus (Rüppell)

(FIG. 2*a*)

Length of longest dorsal ray (usually the fifth) from 21·9 to 28·7 per cent. of the standard length (mean 23·8 per cent.; length of longest anal ray (usually the fourth) from 22·5 to 28·0 per cent. of the standard length (mean 25·3 per cent.). Rays in left pectoral fin (17) 18–19 (20) (2 specimens with 17 rays, 5 with 18 rays, 21 with

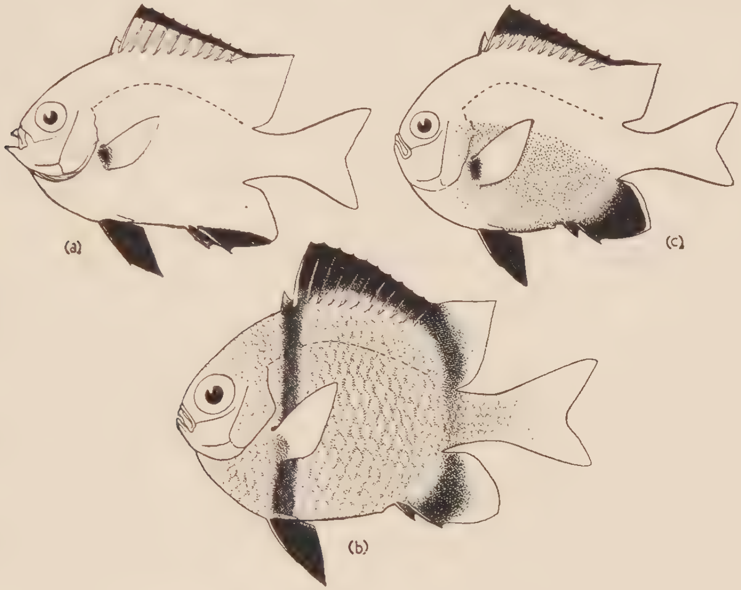

FIG. 2*a*. *Dascyllus marginatus marginatus*. Locality: Dahab, Gulf of Aqaba.

FIG. 2*b*. *Dascyllus marginatus reticulatus*. Locality: Philippine Islands.

FIG. 2*c*. A specimen of *D. marginatus* from Aden—intermediate in certain respects between the two above sub-species.

19 rays, and 1 with 20 rays). General body colour pallid to brownish (in spirits) with the anterior half to two-thirds of the trunk usually tending to be darker in colour than the rest of the body. Upper third to a half of spinous dorsal black; this edging continuing along the soft dorsal as a rather thinner band as far as the tips of the longest dorsal rays. Anal fin with membranes between the spinous and first 5 or 6 soft rays coloured black, contrasting sharply with the posterior half of the fin where the fin membranes are translucent.

Distribution. Red Sea.

Synonymy.

Pomacentrus marginatus Rüppell, 1828. *Atlas Reise nordl. Afrika. Fische des Rothen Meers.*: 38. pl. 8, fig. 2 (type locality: Massaua, Red Sea).

Dascyllus marginatus Cuvier & Valenciennes, 1830. *Hist. Nat. Poiss.* **5:** 439, pl. 133. Günther,

1862, *Cat. Fish. Brit. Mus.* **4:** 14. Klunzinger, 1871, *Verh. zool. bot. Ges. Wien* **21:** 520. Kossman & Rauber, 1877. *Zool. Ergebn. K. Acad. Wiss. Berlin*, **1:** 23. Borsieri, 1904, *Ann. Mus. Civ. Genova* (3) **1** (41): 214. Bamber, 1915, *J. linn. Soc. Lond.* **31:** 481.

The other material studied was as follows:

Specimens from the Gulf of Aden collected by Mr. A. Fraser-Brunner, 3 specimens from Alayu, British Somaliland (from 30·5 to 34·0 mm.); 5 specimens from Berbera, British Somaliland (from 27·5 to 35·5 mm.); 1 specimen from Perim (of 35 mm.); 1 from Aden (of 33·5 mm.) and 1 from Burum near Mukalla, Indian Ocean; 2 from Zanzibar, B.M. Reg. No. 64.11.15.100 and 65.3.18.35 (of 48·0 and 52·5 mm.); Pacific Ocean[1]; 3 from Rotuma, B.M. Reg. No. 97.8.23.141–143 (from 26·0 to 63·5 mm.)[1]; 1 from Borneo, B.M. Reg. No. 58.4.21.363 (of 42 mm.)[1]; 1 from Ponape, B.M. Reg. No. 76.5.19.7 (of 31·0 mm.), and 8 from Duquamete, Or Negros, Philippine Islands, B.M. Reg. No. 1933.3.11.440–7 (from 25·0 to 58·0 mm.). The type specimen of *Dascyllus nigripinnis* Regan was also examined (B.M. Reg. No. 1908.3.23.98).

Dascyllus marginatus reticulatus (Richardson)

(Fig. 2*b*)

Length of longest dorsal ray from 19·8 to 23·2 per cent. of the standard length (mean 21·1 per cent.). Length of longest anal ray from 19·1 to 24·5 per cent. of the standard length (mean 21·3 per cent.). Rays in left pectoral fin (19) 20–21 (1 specimen with 19 rays, 7 with 20 rays, and 8 with 21 rays).

General body colour brown to dark brown (in spirits), the darker edging of the scales often showing up as a reticulated pattern over the body. Spinous dorsal fin dark brown, this pigmentation not extending to the longest rays of the soft dorsal. Anal fin uniformly dark brown, although sometimes the distal half of the fin may appear lighter.

Distribution. Indo-West Pacific area (excluding the Red Sea).

Synonymy. This is not complete, but lists all the names which have been proposed for the Indo-Pacific individuals of this sub-species.

Heliases reticulatus, Richardson, 1845 (1846), *Rep. Brit. Ass. Adv. Sci. Ichth. China & Japan*: 254 (type locality: China Seas).
Tetradrachmum reticulatum, Bleeker, (1872), *Ned. Tijdschr. Dierk.* **2:** 145.
Dascyllus xanthosoma, Bleeker, 1851, *Natuurk. Tijdschr. Ned.-Ind.* **2:** 247.
Dascyllus marginatus, Playfair & Günther, 1866, *Fishes of Zanzibar*, **277:** 81.
Pomacentrus unifasciatus, Kner, 1868, *S.B. Akad. Wiss. Wien*, **58** (1): 31, 348, pl. 8, fig. 24.
Dascyllus nigripinnis, Regan, 1907, *Trans. linn. Soc. Lond. Zool.* (2) **12:** 228, pl. 24, fig. 5. Type locality: Maldives.
Dascyllus trimaculatus (non Rüppell), Fowler, 1918, *Copeia*, **58:** 64.

Finally the specimens from the Gulf of Aden were found to have the following characteristics:

Length of longest dorsal ray 21·4–24·6 per cent. of standard length (mean 22·7 per cent.). Length of longest anal ray 20·6–25·9 per cent. of standard length (mean 22·3 per cent.). Rays in left pectoral 17–19 (1 with 17, 2 with 18, and 8 with 19 rays). Colour in spirits dark purple-brown to brown with the caudal peduncle and the region

[1] These are labelled *Dascyllus xanthosoma.*

over the dorsal half of the body and below the dorsal fin lighter in colour. Distal half to two-thirds of spinous dorsal black, this continuing as a thin edging to the soft dorsal as far as the tips of the largest rays. Anal, except for a lighter posterior edging, brownish black (see fig. 2*c*).

It will be seen that these specimens are in certain respects intermediate between the two sub-species described above. In colour they are much like *D. m. reticulatus*, although that of the dorsal fin is more like *D. m. marginatus*.

In number of pectoral rays they are clearly closest to *marginatus*, but are perhaps intermediate in the height of the longest dorsal and anal rays. The existence of intermediate forms in the Gulf of Aden suggests that this is an area where the two subspecies meet and interbreed. Much more material is required, however, from both the southern end of the Red Sea and the Gulf of Aden to establish the interrelations of the sub-species.

Labridae

Labroides dimidiatus (Cuvier & Valenciennes)

One specimen of 27 mm. caught by hand-net among coral at Mualla.

Thalassoma güntheri (Bleeker)

Four specimens caught by hand-line at the following localities: Sanafir Island, 2 of 105 and 107 mm.; Tiran Island, 1 of 102 mm.; and Sherm Sheikh, 1 of 154 mm.

Thalassoma lunare (Linnaeus)

Two specimens of 115 and 151 mm. caught by hand-line at Ras Muhammad Bay.

Stethojulis axillaris (Quoy & Gaimard)

Two specimens of 53 and 66 mm. taken at Abu Zabad at low tide on the reef.

Stethojulis albovittata (Bonnaterre)

One specimen of 79 mm. taken at Abu Zabad at low tide on the reef.

*****Halichoeres margaritaceus*** (Cuvier & Valenciennes)

Three specimens of 37, 43, and 51 mm. taken at low tide on the reef at Abu Zabad.

Cheilinus mentalis Rüppell

Eight specimens from 55 to 87 mm. taken at Aqaba in a fish trap set at 10 fathoms. De Beaufort (1940) has correctly synonymized *Cheilinus orientalis* Günther with this species. There are no differences between the above specimens and the type specimen (B.M. Reg. No. 1864.5.15.8).

Pseudocheilinus hexataenia (Bleeker)

Four specimens all taken from pieces of coral. Three from Sanafir Island of 19, 23, and 29 mm. and one from Sherm Sheikh of 22·5 mm.

Scaridae

Leptoscarus vaigiensis (Quoy & Gaimard)

One specimen of 100 mm. collected on the reef at Abu Zabad at low tide.

Sub-order ACANTHUROIDEA

Acanthurus nigrofuscus (Forskål)

Three specimens collected at Mualla by cast-net (2 of 57 and 86 mm.) and at Abu Zabad at low tide (1 of 55 mm.).

Sub-order TEUTHIDOIDEA

Teuthis rivulatus (Forskål)

Five specimens taken by cast-net at Um Nageila (3 of 217, 220, and 235 mm.) and Sanafir Island (2 of 130 and 172 mm.).

Sub-order SCOMBROIDEA

Thynnus (Neothunnus) albacora (Lowe)

One specimen of 1,070 mm. obtained from Arab fishermen who were catching this fish and the one following at a depth of about 100 metres, a few miles south of Aqaba.

Euthynnus (Katsuwonus) pelamis (Linnaeus)

One specimen of 670 mm. obtained a few miles south of Aqaba from local fishermen.

Scomberomorus commerson (Lacépède)

One specimen of 860 mm. from Sanafir Island, caught by trolling spoon-bait.

Sub-order GOBIOIDEA

Eleotridae

****Eviota gymnocephalus*** M. Weber

Fourteen specimens, all obtained from pieces of coral brought up by a diver (5 from Sanafir Island from 10·0 to 16·0 mm.; 4 from Sherm Sheikh from 8·0 to 14·0 mm.; 1 from Sherm-el-Moiya of 15·0 mm.; 2 from Graa of 9·5 and 10·0 mm.; and 2 from Dahab of 13·0 and 15·5 mm.).

****Eviota distigma*** Jordan and Seale

Four specimens obtained from pieces of coral at Sherm Sheikh (3 from 13·0 to 17·0 mm.) and Graa (1 of 14·0 mm.).

Heterelotris vulgare (Klunzinger)

Eighteen specimens collected from pieces of coral at the following localities: Sanafir Island (10 from 18·0 to 26·0 mm.), Tiran Island (1 of 17·0 mm.), Mualla (3 from 18·0 to 23·0 mm.), Dahab (4 from 19·0 to 25·0 mm.).

This species has only been recorded from the Red Sea.

Klunzinger (1870) remarks that the body of this fish appears to be without scales. I was also unable to find any trace of scales.

GOBIIDAE

Bathygobius fuscus (Rüppell)

Three specimens collected at Dahab (1 of 34·0 mm.), Mualla (1 of 50·0 mm.), and Abu Zabad (1 of 47·0 mm.). All were taken close inshore where they were found under stones and rocks.

Acentrogobius ornatus (Rüppell)

Two specimens of 38·0 and 58·0 mm. taken under stones at Abu Zabad at low tide.

Gobiodon quinquestrigatus (Cuvier & Valenciennes)

Forty-four specimens, all obtained from pieces of coral at the following localities: Dahab (7 from 16·5 to 38·0 mm.), Sanafir Island (24 from 12·5 to 38·0 mm.), Tiran Island (10 from 16·0 to 37·0 mm.), and Sherm Sheikh (3 from 22·0 to 30·0 mm.).

****Gobiodon erythrospilus*** Bleeker

Three specimens obtained from coral at Dahab (2 of 34·0 and 37·0 mm.) and Tiran Island (1 of 32·0 mm.).

Gobiodon citrinus (Rüppell)

Six specimens obtained from pieces of coral at Sanafir Island (4 from 27·5 to 32·0 mm.) and Sherm Sheikh (2 of 26·0 mm.).

Paragobiodon echinocephalus (Rüppell)

Three specimens from 20·0 to 23·0 mm. taken from a piece of coral at Sanafir Island.

Sub-order BLENNIOIDEA

BLENNIIDAE

Enchelyurus kraussii (Klunzinger)

One specimen of 30 mm. taken from a piece of coral at Graa. This species has only been recorded from the Red Sea.

Cirripectus variolosus (Cuvier & Valenciennes)

One specimen of 31·0 mm. collected on the reef at Abu Zabad.

Istiblennius edentulus (Bloch & Schneider)

Twenty-five specimens collected under stones and rocks at Abu Zabad (15 from 46·0 to 84·0 mm.) and Dahab (10 from 25·0 to 57·0 mm.).

Istiblennius fasciatus (Bloch)

Two specimens from Abu Zabad (1 of 47·0 mm.) and Sanafir Island (1 of 48·0 mm.).

CONGROGADIDAE

Haliophis guttatus (Forskål)

Four specimens obtained from pieces of coral at Sanafir Island (3 of 50·0, 67·0, and 81·0 mm.) and Sherm Sheikh (1 of 60·0 mm.).

This species appears to be restricted to the Red Sea.

CLINIDAE

****Helcogramma trigloides*** (Bleeker)

One specimen of 27·0 mm. found in a piece of coral at Mualla.

Sub-order MUGILOIDEA

SPHYRAENIDAE

Sphyraena jello Cuvier & Valenciennes

One specimen of 530 mm. taken by trolling spoon-bait at Sanafir Island.

Sphyraena picuda Bloch. Schneider

One specimen of 760 mm. taken by spoon-bait at Sanafir Island.

MUGILIDAE

Oedalechilus labiosus (Cuvier & Valenciennes)

Eight specimens taken by cast-net at Mualla (2 of 101 and 104 mm.) and Sherm Sheikh (6 from 96 to 127 mm.).

Liza seheli (Forskål)

One specimen of 300 mm. taken by cast-net at Dahab.

Liza crenilabis (Forskål)

One specimen of 69·5 mm. from Dahab and eight specimens from 101 to 164 mm. from Sanafir Island taken by cast-net.

ATHERINIDAE

Hypoatherina gobio (Klunzinger)

Twenty-nine specimens caught by dip-net and a light at night-time at the following

localities: Dahab (7 from 26·0 to 82·0 mm.), Sanafir Island (13 from 46·0 to 92·0 mm.), and Sherm Sheikh (9 from 20·0 to 74·0 mm.).

This species is apparently confined to the Red Sea.

Sub-order SCLEROPAREI

Scorpaenidae

**Scorpaenopsis albobrunneus* (Günther)

Twenty-two specimens, all obtained from pieces of coral brought up by a diver at the following localities: Dahab (8 from 19·0 to 44·0 mm.), Tiran Island (2 of 35·0 and 40·0 mm.), Sanafir Island (7 from 21·0 to 48·0 mm.), Sherm Sheikh (5 from 19·0 to 35·0 mm.).

Pterois volitans Linnaeus

Three specimens taken at Dahab (1 of 155 mm.), Hobeik (1 of 190·0 mm.), and Abu Zabad (1 of 51·0 mm.).

Order *DISCOCEPHALI*

Echeneididae

Echeneis neucrates Linnaeus

One specimen of 617 mm. caught by hand-line at Sherm Sheikh.

Order *PLECTOGNATHI*

Balistidae

Odonus niger (Rüppell)

Six specimens caught by hand-line at Sherm Sheikh (4 from 143·0 to 186·0 mm.) and Hobeik (2 of 240·0 and 285·0 mm.).

Balistapus undulatus (Mungo Park)

Two specimens. One of 184 mm. caught by hand-line at Hobeik and one of 35 mm. obtained from a piece of coral.

Rhinecanthus assasi (Forskål)

Four specimens taken at Abu Zabad (2 of 205 and 210 mm.) and Sanafir Island (2 of 170 and 190 mm.).

This species seems to be restricted to the Red Sea, the Gulf of Aden, and the Indian Ocean coast of Arabia.

ALUTERIDAE

Oxymonacanthus halli sp. nov.

(FIG. 3)

Two specimens, the holotype of 38·0 mm. and one paratype of 39·5 mm. taken from a piece of coral at Sanafir Island in the northern Red Sea.

(In the description which follows, measurements and counts of the holotype precede those of the paratype which are placed in brackets.)

Body proportions (relative to a standard length of 100): Greatest depth 35·5 (36·1); length of head 34·8 (35·4); predorsal length (from tip of snout to origin of dorsal fin) 55·5 (55·7); preanal length 61·8 (62·0); depth of caudal peduncle 14·4 (13·3); length of pectoral fin 9·9 (9·5); height of first dorsal spine 23·0 (24·0).

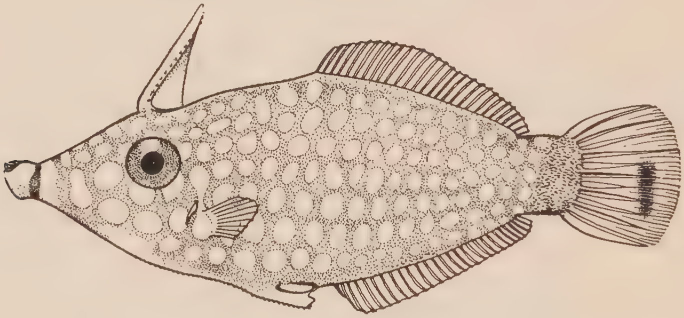

FIG. 3. *Oxymonacanthus halli* sp. nov.

Head proportions (relative to a head length of 100): Length of snout 64·0 (64·3); horizontal diameter of eye 26·4 (25·0).

Fin rays: Dorsal II, 28 (II, 27); anal 27 (25); left pectoral 10 (10); caudal 12.

Body covered with very numerous spinules, which become larger (about twice the length of those immediately behind the eye) and fewer on the caudal peduncle, particularly over the lateral, median regions. These spinules extend out to about three-quarters the length of each caudal ray and are not found on the tip of the snout in front of the brown pigment band which encircles it. First dorsal spine studded anteriorly and laterally with blunt spines, while posteriorly there are two rows of 9 or 10 rather larger blunt spines, the lower of which, at least, project backwards and downwards. Second dorsal spine very small. Immediately posterior to the first dorsal spine there is a fairly deep, wide groove in the back, of much the same length as this spine.[1] Pelvic spine supporting a small ventral flap. Dorsal, anal, and pectoral rays unbranched. Caudal rays branched except for the upper and lower outermost rays which are stouter at the base than the inner rays. Jaws meeting dorsally at the tip of the snout.

General colour blue with longitudinal rows of roughly circular deep yellow spots.

[1] Presumably the long dorsal spine folds into this groove, but I have been unable to unlock the trigger mechanism by pressure on the small second spine.

Between the origin of the dorsal and anal fins nine rows of these spots can be counted. Tip of snout yellow in front of the brown pigment ring which encircles it. Membrane of dorsal fin yellow, pelvic flap orange with a black edging. Caudal with a black vertical bar of pigment. Iris golden with six symmetrically arranged slate blue sectors.

This species differs from *Oxymonacanthus longirostris* (Bloch & Schneider), the only other species of this genus, in the following:

	O. halli	*O. longirostris*[1]
Dorsal rays . . .	27 and 28	31–32
Anal rays . . .	25 and 27	29–30
Pectoral rays . .	10	11–12

In addition there are certain differences in the colour pattern.

1. In *Oxymonacanthus halli* there are no longitudinal yellow stripes in front of the eye as are usually found in *O. longirostris*.
2. There are 9 longitudinal rows of yellow spots (counting across the body between the origins of the dorsal and anal fins) in *O. halli*, whereas in *longirostris* there are usually 7 (occasionally 6 or 8). The number of spots in each row is also greater in the new species. There are 18 or 19 (counting along the row behind the eye), whereas in *longirostris* there are 12–16.
3. In *O. longirostris* there is usually a small area of the abdomen just above the pelvic flap which is differentiated from the rest of the body by being brown in colour and dotted with small white spots. This is absent in the two specimens of *O. halli*.

I have much pleasure in naming this species after Major H. W. Hall, M.C., the owner of M.Y. *Manihine*.

OSTRACIONTIDAE

Ostracion tuberculatus Linnaeus

Two specimens of 270 and 300 mm. taken by cast-net at Sanafir Island.

LAGOCEPHALIDAE

Lagocephalus sceleratus (Forster)

Four specimens from 260 to 280 mm. taken by hand-line at a depth of 10 fathoms at Sanafir Island.

TETRAODONTIDAE

Amblyrhynchotes diadematus (Rüppell)

One specimen of 146 mm. taken by cast-net at Mualla. This species is confined to the Red Sea.

[1] Counts and measurements based on specimens from Samoa (1) (standard length 79·0 mm.), Amboyna (1 of 70·0 mm.), Ponape, Caroline Islands (2 of 43 and 65 mm.), New Britain (1 of 57·0 mm.), and one (no locality given) from Bleeker's collection (67 mm.).

Arothron hispidus (Linnaeus)

Two specimens of 285 and 340 mm. taken by cast-net at Sanafir Island.

These two specimens and another from the Gulf of Suez all have much more numerous and smaller white spots on the body than in examples taken outside the Red Sea.

CANTHIGASTERIDAE

***Canthigaster cinctus** (Solander)

One specimen of 65 mm. taken by a fish-trap at Aqaba from a depth of 10 fathoms.

DISCUSSION

Among the 113 species considered in this report are a number which appear to be confined to the Red Sea. They may be subdivided as follows:

A. Almost certainly endemic

Pseudochromis olivaceus Rüppell
Crenidens crenidens crenidens (Forskål)
Diplodus noct ((Ehrenberg) Cuvier & Valenciennes)
Chaetodon fasciatus Forskål
Dascyllus marginatus marginatus (Rüppell)
Haliophis guttatus (Forskål)
Hypoatherina gobio (Klunzinger)
Amblyrhynchotes diadematus (Rüppell)

B. Possibly endemic

Heterelectris vulgare Klunzinger
Enchelyurus kraussii Klunzinger
Oxymonacanthus halli Marshall

(The first two species are small and inconspicuous)

C. Species with Red Sea forms distinguishable from those of the Indian Ocean

Spratelloides gracilis (Schlegel)
Therapon jarbua (Forskål)
Platax orbicularis (Forskål)
Arothron hispidus (Linnaeus)

The number of species collected by this expedition probably represents about one-fifth of the total fish fauna of the Red Sea (Klunzinger, 1870 and 1871, lists about 490 species). If it is a representative sample, then about 10 per cent. of the species (and sub-species) known from this area are endemic. Moreover, to judge from the work on this collection, this percentage may well prove to be considerably higher, when more material becomes available for study.

Before discussing how these endemic elements may have originated it will be necessary to outline briefly the geological history of the Red Sea area. Although

the evidence is rather incomplete it seems that the formation of the main physical features were completed during the Pliocene and that during this time the Red Sea became connected with the Gulf of Aden and the Indian Ocean. Fox (1926) suggests that the invasion of Indian Ocean species into the Red Sea occurred some time after the Middle Pliocene. (Earlier an ancestral Red Sea appears to have come into being as the result of the faulting of Eocene strata followed by the filling of the resulting depression with water from the north. Later on the Red Sea appears to have lost its connexion with the northern Tethys Sea, for during Miocene times it shrank in area giving rise to great deposits of rock salt.) Continuing from middle Pliocene times there seems no doubt that there was again a connexion between the Mediterranean (Tethys Sea) and the Red Sea (the latter now containing a mixed Mediterranean and Indian Ocean fauna), but when the Gulf of Suez became cut off from the Mediterranean is not very certain.

This would seem to be the generally accepted geological history of the Red Sea, but Sewell (1948) has considered the implications of Zeuner's (1945) work on the Pleistocene period. Zeuner suggests that during the last Glacial period the sea-level fell as the result of ice formation, his figure for the Mediterranean being -100 metres, while a low level of -200 metres has been suggested for the penultimate glaciation.

Sewell (1948) concludes that this lowering of sea-level might well have left the shallow sill at the southern end of the Red Sea uncovered, which '. . . must have resulted in the almost complete disappearance of the Red Sea as it exists today and its reduction to two small inland lakes which were in all probability hypersaline. Under such changes as these it is difficult to suppose that anything of the marine fauna can possibly have survived, and the original fauna of the Tethys Sea that was derived from the Indo-Pacific region must have disappeared.' Following from this the sea-level once again rose at the end of the Glacial period, resulting in a second and final influx of species from the Indian Ocean into the Red Sea.

Concerning the origin of forms peculiar to the Red Sea there are certainly two possibilities:

1. That they have evolved from species entering the Red Sea.
2. That they may be the only survivors of species which originally lived in the Indian Ocean. It might be suggested, for example, that the Indian Ocean representatives of these species have been eliminated during geological history whereas conditions in the Red Sea favoured their survival.

A third possibility of whether the endemic forms are relics from the ancestral Red Sea seems so unlikely that it will not be considered beyond pointing out that the presence of great rock-salt deposits, probably of Miocene age, implies that this early sea must have been subject to extensive evaporation. As already mentioned, Sewell (1948) concluded that this would be likely to happen and that it most probably resulted in a mass extinction of the marine fauna.

Beginning with the second suggestion, it seems somewhat improbable that this fairly high number of endemic forms should have all possessed the potentialities of surviving in the Red Sea while the Indian Ocean ancestral stock perished. Following

the formation of the 'modern' Red Sea the main hydrological features would gradually have evolved, that is, higher summer temperatures and greater salinities, which now distinguish it from the Indian Ocean. Such changes would have tended to bring about correlated changes in the fish fauna (among them extinction) rather than the preservation of species. To put it another way, it seems unlikely that these forms should have all been pre-adapted to conditions in the Red Sea. While it is not possible to state the latter with certainty, it is of interest that the Red Sea supports fewer species of fishes than the Indian Ocean. Sewell (1948) has similar findings for the free-swimming planktonic Copepoda and suggests that many species which are widely distributed in the Indo-Pacific are unable to survive the changes in salinity and temperature on being carried into the Red Sea.

Turning to the first suggestion, if a number of the ancestral Indian Ocean immigrants have evolved into species and sub-species peculiar to the Red Sea, there should be some evidence for this today. It would be reasonable to expect to find at least some of these endemic Red Sea forms pairing off with the present-day Indian Ocean representatives. Regan (1906–1908) and Meek & Hildebrand (1923), when considering the marine fishes of Panama, have remarked on the many close parallels between the faunas of the opposite sides of the isthmus. It is generally considered that the formation of the Isthmus of Panama during late Pliocene times separated many species into Atlantic and Pacific populations which have diverged in isolation.

In the Red Sea there are certain endemic species which are paired with others from the Indian Ocean. From this collection there are the following pairs:

Red Sea	*Indian Ocean*
Diplodus noct (C.V.)	*Diplodus sargus* (L.) (also occurs in the Med.)
Chaetodon fasciatus Forskål	*Chaetodon lunula* Lacépède
Haliophis guttatus Forskål	*Haliophis malayanus* M. Weber
Oxymonacanthus halli Marshall	*Oxymonacanthus longirostris* (Bloch & Schneider)

While the members of these pairs may well have arisen by the separation of an original species into Red Sea and Indian Ocean populations, they are not sufficiently closely related to draw any certain conclusions as to their past history. Instead, it will be better to concentrate on infra-specific categories. Here there are the proposed sub-species of *Dascyllus marginatus* and the examples listed earlier of differences between Red Sea and Indian Ocean populations of certain species. Judging from the impressions gained in working out this collection and from numerous instances in the literature[1] where Red Sea examples of a species can be distinguished from others from the Indian Ocean, there can be little doubt that when good series of specimens from both areas are available, more species will be found to have Red Sea 'forms'.

The evolution of these endemic elements implies that after entering the Red Sea they became isolated to some degree. Leaving aside problems concerning the Suez Canal, entry via the Gulf of Aden is through the narrow Strait of Bab-el Mandeb, inside which is a shallow sill, where the greatest depth is only about 100 metres. Climatic conditions and the basin-like character of the Red Sea are the predominating

[1] Particular reference may be made to Fraser-Brunner (1950), who remarks that '... among the Chaetodonts at least I find that few or none of the known Red Sea forms are identical with those outside'.

factors controlling the temperature and salinity of the waters, and as already mentioned, the latter features were evolved after the formation of the 'modern' Red Sea. Today very soon after entering the Red Sea the salinity rises by about 2‰ and in summer the surface temperature increases by about 3–5° C. In winter there appears to be little difference between the surface temperatures of the Red Sea and the Gulf of Aden (data from Sverdrup, Johnson, & Fleming, 1942).

Perhaps this quite abrupt change in one or both physical factors may be a barrier to the exchange of Red Sea and Gulf of Aden fishes and has been so long enough for new forms to have arisen. Perhaps the habits of the fishes themselves may be another factor, species which are closely dependent on coral life and less migratory being more prone to differentiation than the more active pelagic species. (While there is the possibility of the larvae of the former types being carried out of the Red Sea (or into it), younger stages are usually more 'exacting' than adults in the physical conditions necessary for their existence; thus such an event may prove disastrous.) Again owing to the changes in temperature and salinity which have occurred since the formation of the Red Sea, certain species may have become reproductively isolated from their Indian Ocean ancestors, through the evolution of differing breeding seasons. In conclusion, however, it should be added that these are no more than suggestions to be tested in the light of further knowledge.

If more data were available on the fish fauna it would be interesting to compare and contrast the Red Sea–Indian Ocean relationships with those found across the Straits of Panama. Concerning the latter area, Gilbert & Starks (1904) in discussing the parallels between the two faunas concluded that:

> 'The ichthyological evidence is overwhelmingly in favour of the existence of a former open communication between the two oceans, which must have closed at a period sufficiently remote from the present to have permitted the specific differentiation of a very large majority of the forms involved. That this differentiation progressed at widely varying rates in different instances becomes at once apparent. A small minority of the species remain wholly unchanged, so far as we have been able to determine that point. A large number have become distinguished from their representatives of the opposite coast by minute (but not "trivial") differences which are wholly constant. From such "representative forms" we pass by imperceptible gradation to species much more widely separated whose immediate relation in the past we cannot confidently affirm.'

Later work by Meek & Hildebrand (1923) did not change these conceptions, except that it was found that fewer species could properly be regarded as common to both coasts and more species were discovered with representative Atlantic and Pacific forms.

It is not proposed on the present limited data to draw conclusions regarding rates of evolution in the Red Sea fauna. Direct comparison with the Panama findings is not, of course, possible for two main reasons: firstly that there is a connexion between the Red Sea and the Indian Ocean (which may make for genetic interchange between the two faunas), and secondly, that there are often greater differences in temperature (but not in salinity) between Red Sea and Indian Ocean waters than exist across the Straits of Panama (this aspect will be discussed later). Whether the degree of endemism of the Red Sea fauna could have been attained since the last Glacial

period (if Zeuner's (1945) figures of drop in sea-levels and Sewell's (1948) conclusions from these are considered), is a question which will best be considered when the large collection of fishes recently obtained from Sudanese waters has been studied.

Finally the fact that the Red Sea is for part of the year warmer and always more saline than Indian Ocean waters must be considered as a 'conditioning factor' in the evolution of Red Sea forms. Before this can be done a list of the differences between closely related forms will be given.

Spratelloides gracilis. The Red Sea populations tend to have fewer pectoral and anal rays than those from the Japanese area.

Therapon jarbua. The Red Sea form has fewer dorsal spines and a slimmer body form.

Diplodus noct. This differs from *D. sargus* from the Indian Ocean in the slimmer body form, the tendency for the dorsal and anal fins to have fewer rays, the smaller number of scale rows above and below the lateral line, and the fewer gill-rakers on the first arch.

Crenidens crenidens. The Red Sea sub-species differs in the slimmer body form, the fewer scale rows above and below the lateral line, and the lesser relative height and length of the soft dorsal and pelvic fins respectively.

Platax orbicularis. Red Sea examples tend to have fewer pectoral rays than those from the Indo-Pacific.

Dascyllus marginatus. The Red Sea sub-species differs from that of the Indian Ocean in the tendency to have fewer pectoral rays, relatively longer soft dorsal and anal fins, and generally lesser developed pigmentation.

Oxymonacanthus halli. Differs from *O. longirostris* from the Indo-Pacific in having fewer dorsal, anal, and pectoral rays. There are also differences in the colour pattern.

It is interesting to consider these differences in relation to present data concerning the correlations of character with environment in fishes. It is well known that the number of fin rays and scales often appears to be inversely related to the temperature with which the above data appear to be in agreement. But a study of the charts of surface temperatures contained in the Monthly Meteorological Charts of the Indian Ocean (M.O. 519. H.M. Stationery Office) shows that from January until May northern Red Sea waters are consistently cooler than those of the Indian Ocean, while evidence is accumulating that many Red Sea fishes spawn during January and February—a problem to be discussed more fully in a later paper. On the other hand, the number of parts of a fish may have a direct relationship with salinity. Precisely what would be the apparent effect of high temperatures and increased salinities on numbers of fin rays or scales in Red Sea fishes (compared to their nearest relatives from the Indian Ocean) is impossible to predict. However, recent work by Heuts (1949) showing the combined effect of temperature and salinity on the number of fin rays in *Gasterosteus aculeatus* may be of particular significance here. Considering only the marine B population, increase in salinity at 10° C. led to an increase in the mean number of dorsal and anal rays, whereas at 23° C. the effect of this was to produce a decrease.

Concerning body form, Hubbs (1940) states that: 'Forms of warmer water, and in the sea those of brackish water, typically have deeper bodies and larger heads than

those of colder or more saline waters.' In the Red Sea there may be a correlation with the increased salinity for in three of the examples listed above, the Red Sea form had a slimmer body shape. More data are desirable before arriving at any conclusions, but these are interesting problems and further comparative studies of Red Sea and Indian Ocean fishes may well contribute to a closer understanding of them. At the same time experimental studies would be desirable. It need only be added that close correlation between environment and structure need not mean that the changes are entirely dependent on the environment. There is evidence from other work that the genotype is also involved. It will be apparent from the recognition of certain sub-species and the trend of this discussion that the view is held that it is unlikely that these correlations solely arise from the action of the environment on the phenotype.

To conclude, it looks as though partially enclosed seas, such as the Red Sea, may be centres for the evolution of new forms. I am much indebted to Dr. A. E. Parr for drawing my attention to the Gulf of California, which also harbours certain endemic species and sub-species. Setchell (1937), referring to earlier work in the gulf, points out that fifteen species or varieties of *Sargassum* are endemic, '. . . thus indicating what is borne out by the remaining marine flora of this body of water, that it forms a "pocket" of more than ordinary distributional interest'. Burkenroad (1938) notes that certain penaeid prawns are confined to the Gulf of California, while Parr (1931) took certain species of deep-sea fishes in the gulf that had originally been described from there by Garman (1899) and have not so far been taken outside this area (although neighbouring areas have been well worked).

More hydrological and biological data will be necessary to discover the degree of isolation of the fauna of these marine pockets. Mayr (1942) has remarked that: 'In the sea isolation is rarely complete and the partially isolated populations are normally very large. It is mainly for this reason that marine species have fewer sub-species than terrestrial species and that the entire evolution in the sea is slower and more conservative.' Further work on partially enclosed areas should help towards an understanding of the evolution of new forms in the seas.

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